DOCUMENT RESUME

ED 256 953 CE 041 529

AUTHOR Solanik, Chuck
TITLE Vocational Electronics Second Year Teacher's Guide and Student Workbook.
INSTITUTION Texas A and M Univ., College Station. Vocational Instructional Services.
SPONS AGENCY Texas Education Agency, Austin. Dept. of Occupational Education and Technology.
PUB DATE 84
NOTE 293p.; For related document, see CE 041 527.
AVAILABLE FROM Vocational Instructional Services, Texas A&M University, F.E. Box 182, College Station, TX 77843.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052) -- Guides - Classroom Use - Materials (For Learner) (051)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Business Skills; Career Education; *Classroom Techniques; Communications; *Course Content; Electrical Systems; *Electric Circuits; *Electricity; Electromechanical Technology; Electronic Equipment; *Electronics; Electronic Technicians; Employment Interviews; Employment Potential; Entrepreneurship; Entry Workers; Industrial Arts; Job Skills; Learning Activities; Learning Modules; *Lesson Plans; Occupational Information; Postsecondary Education; Secondary Education; Teaching Methods; Trade and Industrial Education; Transparencies; Units of Study; Vocational Education

ABSTRACT

This guide is intended to help teachers give preparatory instruction in the development of basic manipulative skills, safety practices, technical knowledge, and related industrial information in order to prepare students for useful employment in the field of electronics. This second-year guide contains 7 units organized into 21 lesson plans. Each lesson plan contains an aim; lists of teaching aids, materials, and references; prerequisites for students; a step-by-step presentation of the lesson (including teaching points, student activities, and things for the teacher to do or say); applications; evaluation; and a summary. Many lesson plans also include information sheets, assignment sheets, tests with answers, task sheets, activities with answer keys, and transparency masters. The following topics are covered in the lesson plans; technical skill development, employment skills, job interview preparation, employer-employee responsibility, AC mathematics, R-L-C circuits, semiconductors, diodes, transistors, special semiconductors, power supply circuits, amplifier circuits, oscillator circuits, digital introduction, digital logic gates, sequential logic circuits, communications systems, electronic systems, career opportunitities in electronics, opportunities in free enterprise, and business fundamentals. A brief bibliography completes the teacher's guide. The student workbook, keyed to the teacher's guide, includes all or several of the following elements for each lesson: information sheets, assignment sheets, tests, task sheets, student activities, and puzzles. (KC)

ED256953

CE041529

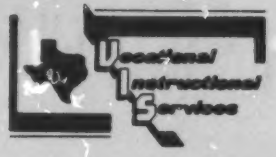
TR841330

SECOND YEAR
TEACHER'S GUIDE
FOR
VOCATIONAL ELECTRONICS

Written by Chuck Solanik

Illustrated by Mike Harrison

Published by
VOCATIONAL INSTRUCTIONAL SERVICES
VOCATIONAL INDUSTRIAL EDUCATION
TEXAS A&M UNIVERSITY
F. E. BOX 182, COLLEGE STATION, TEXAS 77843



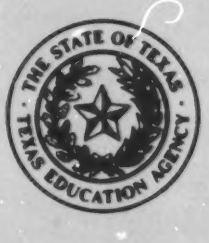
In Cooperation With
VOCATIONAL INDUSTRIAL EDUCATION
OCCUPATIONAL EDUCATION AND TECHNOLOGY
TEXAS EDUCATION AGENCY

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization orginating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.



All Rights Reserved

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

F Page

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

C. 2

INTRODUCTION

The purpose of this course is to give instruction of a preparatory type in the development of basic manipulative skills, safety practices, technical knowledge, and related industrial information in order to fit students for useful employment in the field of electronics. Vocational Electronics Course of Study is conveniently divided into first and second year, with a separate set of transparencies to accompany each. The Student Workbook for Vocational Electronics is also divided into first and second year. All of the above are available from Vocational Instructional Services. However, since the author, Mr. Chuck Solanik, feels that since several good lab manuals were already available, he suggests using Introduction to Electricity and Electronics for lab experiments. This manual is listed in the bibliography.

COMPETENCY BASED OBJECTIVES

Upon successfully completing this competency based, two-year course of study the student will be able to:

1. Identify safe working practices and demonstrate skills in working safely.
2. Demonstrate proper techniques in the use, maintenance, and storage of tools and equipment used in electronics work.
3. Demonstrate understanding of direct current electronics related to current flow and voltage development related to resistance.
4. Demonstrate understanding of Ohm's law and power.
5. Describe magnetism as it relates to inductance.
6. Design and build direct current circuits using bread board and printed circuits.
7. Demonstrate understanding of alternating currents as related to measurements, waveforms, capacity and inductive circuits, and transformer and tuned circuits as used in radio and television.
8. Identify generators determining values of sinusoidal and nonsinusoidal waves.
9. Determine resistance in alternating current circuits.
10. Describe effects of resistors, capacitors, and inductors on alternating current.
11. Demonstrate and apply the characteristics of series parallel resonant circuits as found in radio and television.
12. Relate the frequency response of bend-pass, bend-stop, high-pass, and low-pass filters related to radio and television.
13. Demonstrate understanding of semi-conductors structure and operation.
14. Test semi-conductor diodes/transistors using volt-Ohm meters.
15. Describe Zener diodes as they apply to voltage regulation.
16. Demonstrate the operation of transistors by observing and measuring their electrical characteristics.
17. Relate the basic theory of frequency modulation.
18. Apply frequency modulation as related to modulation percentage; side bend; radiated power; and modulator systems including direct FM, indirect FM, reactance tube modulator, serrasoid modulator, and stereophonic multiplexing.
19. Demonstrate understanding of television systems and subsystems.
20. Demonstrate understanding of digital electronic circuits.
21. Demonstrate understanding of micro processor theory and logic.
22. Describe opportunities in the free enterprise system.

ACKNOWLEDGEMENTS

A sincere note of gratitude to Mr. Chuck Solanik, electronics instructor at John Jay High School in San Antonio, who found time in his busy schedule to compile the materials and develop this Vocational Electronics Course of Study.

Appreciation is also extended to the people in the electronics industry who gave freely of their time in making this publication possible. Especially helpful were the following:

Mr. Mike Vasquez, Engineering Technician, Datapoint Corporation

Mr. William McGinnis, Manager, Electromagnetic Compatibility Services, Southwest Research Institute

Mr. Roger Roeder, Service Manager, Muzak Systems of San Antonio

Mr. Paul Boatright, Vice President, OI Corporation

Mr. Don Ling, Electronic Technician, Texas Instruments, Inc.

Mr. Collin McKinney, Engineer, Texas Instruments, Inc.

Mr. J. Michael Andrewartha, Engineer, Micon Engineering, Inc.

Mr. R. Page Heller, P.E., Vice President, Micon Engineering, Inc.

TABLE OF CONTENTS

VII-A-	Technical Skill Development	1
	Technical Skill Development Assignment Sheet	3
	Project Rating Sheet	4
-B-	Employment Skills	5
	Finding and Applying for a Job Information Sheet	8
	Sample Letter of Inquiry Information Sheet	11
	Personal Data Sheet Assignment Sheet	12
	Application Assignment Sheet	13
	Test Key	14
-C-	Job Interview Preparation	15
	Job Interview Preparation Information Sheet	17
	Crossword Puzzle Key	20
-D-	Employer-Employee Responsibility	21
	Employment Responsibility Information Sheet	24
	Employer-Employee Assignment Sheet Key	28
	Test Key	30
VIII-A-	AC Mathematics	31
	AC Mathematics Assignment Sheet Key	34
	Test Key	36
-B-	R-L-C Circuits	39
	R-L-C Circuits Assignment Sheet Key	44
	Test Key	46
IX-A-	Semiconductors	49
	Semiconductor Assignment Sheet Key	52
	Test Key	54
-B-	Diodes	55
	Diode Assignment Sheet Key	59
	Diode Testing Task Sheet	61
	Test Key	62
-C-	Transistors	63
	Transistor Assignment Sheet Key	66
	Transistor Testing Task Sheet	68
	Test Key	69
-D-	Special Semiconductors	71
	Special Semiconductors Assignment Sheet Key	74
	Test Key	76
X-A-	Power Supply Circuits	77
	Power Supply Circuits Assignment Sheet Key	81
	Test Key	83
-B-	Amplifier Circuits	85
	Amplifier Circuits Assignment Sheet Key	89
	Test Key	91
-C-	Oscillator Circuits	93
	Oscillator Circuits Assignment Sheet Key	96
	Test Key	98

XI-A- Digital Introduction---------- 99
Digital Introduction Assignment Sheet Key---------- 101
Test Key---------- 102
-B- Digital Logic Gates---------- 103
Digital Logic Gates Assignment Sheet Key---------- 106
Test Key---------- 108
-C- Sequential Logic Circuits---------- 109
Sequential Logic Circuits Assignment Sheet Key---------- 111
Test Key---------- 113

XII-A- Communications Systems---------- 115
Communications Systems Assignment Sheet Key---------- 118
Test Key---------- 119
-B- Electronic Systems---------- 121
Electronic Systems Assignment Sheet Key---------- 123
Test Key---------- 124

XIII-A- Career Opportunities in Electronics---------- 125
Career Opportunities Assignment Sheet Key---------- 128
Test Key---------- 129
-B- Business Opportunity in Free Enterprise---------- 131
Business Opportunity Assignment Sheet Key---------- 134
Essay Test---------- 136
-C- Business-What You Need to Know---------- 137
Business Assignment Sheet---------- 142
Essay Test---------- 144

BIBLIOGRAPHY---------- 147

INSTRUCTOR'S PLAN VII-A-1(I)
INFORMATIONAL LESSON

SUBJECT: Technical Skill Development

AIM: Upon successful completion of the lesson, the student will be able to select, plan and construct an electronics project.

TEACHING AIDS:

MATERIALS: Assignment Sheet - Technical Skill Development
Test Sheet - Technical Skill Development

TOOLS AND EQUIPMENT: All available tools

REFERENCE: Malcolm, Douglas, How to Build Electronic Projects, Mc-Graw-Hill Gregg Division, New York, 1980

PREREQUISITE EXPERIENCE OF THE LEARNER: All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

In this lesson, you will develop the skills learned in previous lessons. You will be responsible for the selection, planning, parts purchasing, construction and final checkout of your project. These skills are some of the many you will be called on to perform in industry. The end "product" is your primary concern in this lesson. All of your work will be evaluated based upon the end product. Neatness and quality of your work is important.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Project Selection	1. Consider costs 2. Student capabilities 3. Time 4. Usefulness
B. Planning	1. Select project 2. Draw schematic diagram 3. Estimate cost 4. Determine construction methods a. Printed circuit board b. Perforated circuit board c. Point-to-point wiring 5. Determine packaging 6. Instructor's approval

II. PRESENTATION (CONT'.)

C. Construction
1. Purchase parts
2. Breadboard circuit
3. Modify circuit if needed
4. Construct permanent circuit
5. Install in case
6. Check operation

D. Evaluation
1. Final check by student
2. Have instructor evaluate project

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Technical Skill Development
2. Monitor and help students on an individual basis
3. Check each student's work for completeness
4. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

1. Ask oral questions
2. Evaluate project using Test Sheet
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss project and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Employment Skills

Name _____ Date _____

Directions: After selecting a project, make an estimate of the total cost using current component catalogs. Draw the schematic diagram of the project on a separate sheet. When you have completed this, discuss the project with your instructor. The instructor must approve the project before you begin work.

Project: _____ Instructor's Approval: _____

Description: _____

_____

Const. Method: _____ Total Estimated Cost: _____

Parts List:	Cost:	Parts List:	Cost:

TEST VII-A-1(T)

PROJECT RATING SHEET

Name _____ Date _____

Project: _____ Total Points: _____

CIRCUIT LAYOUT

0	1	2	3	4	5	LAYOUT AND ARTWORK NEATNESS
0	1	2	3	4	5	COMPONENT SPACING
0	1	2	3	4	5	CONDUCTOR AND PAD SIZE
0	1	2	3	4	5	MOUNTING
0	1	2	3	4	5	BOARD SIZE

SOLDERING

0	1	2	3	4	5	COLD SOLDER CONNECTIONS
0	1	2	3	4	5	EXCESS SOLDER
0	1	2	3	4	5	SOLDER BRIDGES OR SPLATTER
0	1	2	3	4	5	NEATLY TRIMMED COMPONENT LEAD

COMPONENT PLACEMENT

0	1	2	3	4	5	COMPONENTS IN CORRECT LOCATION
0	1	2	3	4	5	CORRECT POLARITY OBSERVED
0	1	2	3	4	5	PARTS SEATED ON BOARD
0	1	2	3	4	5	COMPONENT MARKINGS VISIBLE

PACKAGING

0	1	2	3	4	5	ADEQUATE SIZE AND STYLE
0	1	2	3	4	5	PARTS WELL FASTENED
0	1	2	3	4	5	CONTROLS IDENTIFIED

WORKMANSHIP

0	1	2	3	4	5	NEAT WIRING
0	1	2	3	4	5	OVERALL APPEARANCE
0	1	2	3	4	5	WORKMANSHIP
0	1	2	3	4	5	PROPER OPERATION

INSTRUCTOR'S PLAN
INFORMATIONAL LESSON

VII-B-1(I)

SUBJECT:	Employment Skills
AIM:	Upon successful completion of the lesson, the student will be able to describe the steps most often used in locating and applying for a job.
TEACHING AIDS:	Newspaper want ads Information Sheet - Finding and Applying for a Job Information Sheet - Sample Letter of Inquiry Assignment Sheet - Personal Data Sheet Test Sheet
MATERIALS:	None
TOOLS AND EQUIPMENT:	None
REFERENCE:	Woodburn, Clint H., Development of Professional Attitudes, Vocational Instructional Services, Texas A&M University, F.E. Box 182, College Station, TX 77843
PREREQUISITE EXPERIENCE OF THE LEARNER:	None

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Most people change jobs at least five times during their working lifetimes. For many this is a simple "drifting" process in that they go from one to another without a specific goal in mind. But others will move from job to job with a single purpose - that they should be "stepping up" to something bigger and better each time. Since there is more competition for these better positions, the person who is upward motivated should be well acquainted with all of the most successful methods of job hunting.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Word-of-mouth	1. Friends and relatives 2. Account for 50% of hiring 3. Positions filled before advertised 4. Do not abuse this method
B. Personal Contacts	1. Going to businesses 2. Talking to employers 3. Requires skill a. Good appearance b. Convincing personality 4. Second most effective method

C. Newspaper Ads
1. Employer advertisements
   a. Answer ad quickly
   b. Be well prepared
2. Advertise for position wanted
   a. Be specific
   b. Be easily contacted

D. Letters of Inquiry
1. Shopping for out of town job
2. Important information
   a. Personal data
   b. Education background
   c. Work experience
3. State position desired
4. Request interview
5. Neat and correct is important

E. Employment Agencies
1. State agency
2. Private agencies
   a. Usually charge a fee
   b. Fee often paid by employer
3. Community organizations
4. Labor unions
5. School counseling - placement

F. Letter of Application
1. Provides handwriting sample
2. Method of selling oneself
3. Employers often ask for one
4. If done properly, can make a good impression:
   a. If possible, write to a person
   b. Check spelling of names
   c. Be brief and original
   d. Write in ink or type
   e. Use good paper without letterhead unless it is your own
   f. Be neat
   g. Check spelling and punctuation
   h. Ask for interview
   i. Closing paragraph is important

G. Personal Data Sheet
1. Presents personal information
   a. Age and citizenship
   b. Marital status
   c. Physical stature and general health
   d. Educational background
   e. Work experience
   f. Skills and hobbies
   g. References
2. Greater detail than letters

H. Formal Application Form

1. Vary between businesses
2. Ask for basic information
3. Helpful suggestions:
   a. Read instructions and follow exactly
   b. Very neat and legible
   c. Do not skip blanks
   d. Read questions carefully
   e. Have all information with you

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Have students write letters of inquiry
2. Have students develop a personal data sheet
3. Have students complete the application form
4. Assist and check student progress

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

1. Ask oral questions
2. Evaluate assignments
3. Test and evaluate
4. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss main job finding methods
2. Review main points of employer contract methods

THE NEXT LESSON IS: Job Interview Preparation

The primary purpose behind education, and vocational education in particular, is to equip people with skills and knowledge so that they may lead happy, productive lives. Since we live in a highly mobile society and may change jobs several times before "settling down", our education is incomplete if we have no knowledge concerning methods for locating employment.

Many surveys and studies have been conducted to determine better ways of finding a job. Some of these methods are discussed below. The job seeker should keep in mind that good judgement should be used with each of them.

Suggestions from relatives and friends - About 50% of the jobs obtained have been secured through helpful tips from some relative or friend. Many times positions are filled by this method before the job opening is advertised or reported to the employment agency.

It is important to remember that job seekers should neither expect nor use influential aid from friends or relatives that would misrepresent their willingness or capabilities. Nothing is accomplished for either the employer or the employee when a relative or friend helps get a job for someone who is neither interested in the job nor qualified for the position.

Personal Contacts - This is the second most effective method for locating employment. It involves walking to various employer's offices, knocking on doors, and sitting in waiting rooms. It is important to remember when making personal contacts that skill in "selling yourself" is necessary for success. People are hired only after they have convinced the employer that they would be an asset to the company.

Newspapers - When answering a newspaper ad, either by letter, telephone, or in person, the job seeker should remember that the sooner the contact is made the better the chance of getting the job. Another way to use the newspaper to find a job is to place a personal ad in the "situation wanted" section. When using this method, job seekers should make sure they can be easily contacted by prospective employers.

Letter of Inquiry - The letter of inquiry or letter of application is an excellent means of locating employment in other towns or areas. It should contain all the necessary information relating to personal data, education, experience background, etc. It should also clearly state the position being applied for and request a formal application and an interview. Many employers prefer that letters of this nature be handwritten because they feel they are able to interpret many of an individual's characteristics from the handwriting. For this reason, a letter of inquiry should be very carefully worded with special attention to the punctuation, spelling, and neatness.

Employment Agencies - The term "employment agency" is not restricted to the state

employment service, but includes the local school counseling service, community employment organizations, and private employment companies. These agencies usually maintain trained placement personnel who may be of assistance to the job seeker.

Letter of Application - After job seekers have done the groundwork of securing information on job leads and have learned as much as possible about the company, they are then ready to contact the employer. This may be done by personal contact or by writing a letter of application. In many instances, even after a personal contact is made, the employer will request a letter of application. This gives the employer a handwriting sample and is a clue to the applicant's ability to express ideas in sentence form. Also, there are times when a written letter of application is the only way of getting a job interview.

A letter of application should be written in the following situations:

1. When applying for a position out-of-town.
2. When seeking an interview with an employer who is a family friend.
3. When answering a newspaper ad that requests one.
4. When an employer requests that a letter of application be written.

A letter of application is a means of selling oneself to the employer. It will, therefore, need to make a good first impression. The following suggestions will help in writing a letter of application that will get attention.

1. If at all possible, the letter should be written to a specific person, not merely to the firm.
2. Be sure that all names are spelled correctly. If necessary call by telephone to verify spelling of names.
3. Be brief and original. Come to the point quickly.
   a. Start the letter by stating exactly what position or type of position is being sought.
   b. Do not go into ability or background. Enclose an outline of the details or leave them for the interview which may follow later.
4. Type the letter or write neatly. Never use pencil. Use short paragraphs and limit the letter to one page.
5. Use a good quality of standard size paper.
   a. Write only on one side and avoid erasures.
   b. Do not use letterhead stationery unless it is your own.
6. Use correct spelling and punctuation.
7. Have an effective closing paragraph.
   a. Be sure to ask for an interview at the employer's convenience.
   b. Use business-like closing.

Personal Data Sheet - A well written letter of application may be all that is necessary to get a job interview. However, it is sometimes advantageous to include additional

information in a personal data sheet. This is an accepted way of presenting information that is not in the letter of application. The personal data sheet may include facts concerning physical stature and general health, courses taken in school, work experience, skills, hobbies, and references. It may be better to list these details on a data sheet instead of including them in the letter of application.

Application Forms - If the job is applied for in person instead of by mail the usual procedure is to fill out an application form prior to the interview. A copy of the personal inventory or data sheet is very helpful in completing the application form. A person should also have three references with correct addresses and telephone numbers. These people should be contacted in advance to get their permission to be used as references.

Written application forms will vary from business to business, but the information on a personal inventory form is always basic. One should also remember that no matter what type of form is used a great deal of information can be gained by the employer concerning the applicant's neatness and ability to complete the form.

The following suggestions may be helpful in filling out application forms.

1. Read the instructions carefully and follow them exactly. The form will usually indicate a preference for pen or pencil and whether writing or printing is to be used.

2. Always write or print neatly and legibly and be careful of messy erasures and soiled appearance of the completed form.

3. Do not omit any questions which apply and if there is no answer, write "none" or "N.A." for "not applicable" in the blank provided for the answer.

4. Read each question carefully and understand it completely before beginning to write.

5. Have an information sheet with names and addresses of personal references, employment history, education background, health record, and other pertinent information.

P.O. Box 000
Townville, Texas 77807

September 21, 1985

Mr. Bill Bartley, Manager
Big Town Electronics
310 Main Street
Townville, Texas 77807

Dear Mr. Bartley:

Mr. Smith, industrial cooperative training teacher-coordinator at Townville High School, has informed me of a vacancy in the computer repair department of your firm. I would like to submit my name to be considered for the position.

At present I am a senior enrolled in the industrial cooperative training program at Townville High. I am therefore available for employment after 1:00 p.m. on school days and for the entire day on Saturdays.

I have completed two years of pre-employment lab training in vocational electronics, and last summer I worked for Downtown Computer Center. I am a member of the Vocational Industrial Clubs of America, and this past spring placed second in the vocational electronics skill contest at the District Meet.

I am interested in a career in the electronics industry and recognize the value of being associated with a firm of your reputation. I would appreciate a personal interview with you at your earliest convenience so you may become better acquainted with my qualifications. I am available for an interview after 1:00 p.m. on school days and any time on Saturdays.

I may be contacted at the above address or through Mr. Smith at the high school. I am looking forward to your reply.

Sincerely,

John McMahan

PERSONAL DATA SHEET VII-B-1(AS)

Personal

Name _____

Address _____ Phone _____

Age _____ Height _____ Weight _____

Health _____

_____

Education

High School _____

Subjects _____

_____

Organizations

Leadership Activities

Work Experience

Skills

Hobbies

References

APPLICATION VII-B-1(AS)

Name _____ Social Security No. _____

Present Address _____ Home Phone No. _____

Date of Birth: Month _____ Day _____ Year _____ Age _____

Do you live with parents? _____ Relatives? _____

What kind of vocational courses have you taken? _____

_____

How many years of vocational coursework have you completed? _____

Who referred you for occupational experience? _____

List hobbies or recreational activities you enjoy: _____

_____

What sports do you enjoy? _____

In what extracurricular activities do you participate? _____

_____

(Education)

	School	City	Dates From To	Graduated
Elementary				
High School				
Other				

List each machine you can operate: _____

_____

Have you learned a trade? _____ Kind: _____

How soon would you be available for work? _____

(Health)

Name of family physician _____ Your Height _____ Weight _____

What illnesses or operations have you had in recent years? _____

_____

Were you ever injured while working? _____ How many times? _____

Are you physically handicapped? _____ Describe: _____

Person to notify in case of emergency: _____

Relationship _____ Address _____ Phone _____

Signature _____ Date _____

TEST VII-B-1(T)
Key

Name _____ Date _____

Directions: Read each question or statement carefully. Write the answers in the spaces provided.

1. List five methods a person can use to find a job.

   a. Suggestions from friends and relatives

   b. Personal contacts

   c. Newspaper

   d. Letters of inquiry

   e. Employment agencies

2. Name two ways a newspaper can be used to find a job.

   a. Looking in the "help wanted" section

   b. Placing a "situation wanted" ad yourself

3. If you plan to use someone for a reference, what is the first two things you should do?

   a. Get their permission

   b. Record their address and telephone number

4. What should you put for an answer if the question asked on an application does not relate to you?

   None or N.A.

5. So that you do not have to rely on memory, what should you take with you when applying for a job?

   Information sheet with school record, employment history,

   references, and all other pertinent information.

INSTRUCTOR'S PLAN VII-C-1(I)
INFORMATIONAL LESSON

SUBJECT: Job Interview Preparation

AIM: The student will be able to explain how to prepare for a job interview, what types of questions one should expect, and some of the more important "don'ts" during an interview.

TEACHING AIDS: Information Sheet - Job Interview Preparation
Assignment Sheet - Crossword Puzzle

MATERIALS: None

TOOLS AND EQUIPMENT: None

REFERENCE: Woodburn, Clint H., Development of Professional Attitudes, Vocational Instructional Services, Texas A&M University, F.E. Box 182, College Station, TX 77843

PREREQUISITE EXPERIENCE OF THE LEARNER: None

I. PREPARATION (OF THE LEARNER - MOTIVATION)

One of the sure signs of intelligence and maturity is being able to see something in the mind's eye from another angle. This also applies in the ability to understand a question from another person's point of view. Suppose you were in business for yourself and needed a new piece of equipment so you could a better, faster, more profitable job. You have several to choose from, and they all cost about the same. Would you make a quick random decision or would you look over the equipment carefully to select the one that could make you the most money? Though it might sound rather blunt, this is basically the same process that is happening at every job interview. Employers are trying to find the people who, in the long-run, will make the most money for their place of business.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Purpose of Interview	1. Face-to-face evaluation 2. Compares to final exam 3. Employer is shopping around
B. Procedure	1. Receptionist a. Very important b. Opinion carries weight 2. Interviewer a. Leads conversation b. Looks for qualities

C. The Applicant
1. Compared to salesperson
2. Knows what they are selling
   a. Write personal inventory
   b. Know what you're selling

D. The Company
1. Know the firm
   a. Products and services
   b. Size and location
2. Makes good impression
3. Talk to employees

E. The Interview
1. Personal appearance
   a. Clean and neat
   b. Not overdressed
   c. No smoking
   d. Consider yourself a guest
2. Be prompt
3. Go alone

F. If Not Successful
1. Try again
2. Learn from mistakes
3. Nobody bats a thousand
4. Prepare yourself better

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Have students write a personal inventory
2. Students should work the crossword puzzle on an individual basis
3. Do practice or mock interviews

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

1. Ask oral questions
2. Check crossword puzzles
3. Evaluate personal inventories

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss main points of the lesson
2. Review possible questions in information sheet

THE NEXT LESSON IS: Employer/Employee Responsibility

The twenty to thirty minutes spent in an interview can be some of the most important time an applicant will spend in procuring a job. For no matter how well letters of application and forms are filled out, the true test is in the employer's face-to-face evaluation. The applicant should, therefore, study and make detailed preparations for this final exam - the interview.

The applicant should remember that the first impression is generally a long lasting one. Also, the person being interviewed must make a favorable impression on the employer the first time, because usually there is only one personal interview. The success or failure of the applicant in securing the position depends to a large extent on the impression made on the employer.

The purpose of the interview is to permit the employer to learn some things about the applicant - attitude toward people and work, education and work experience, future career plans, and goals in life. The reason employers are interested in these things is the desire to get the best possible person for the position. Just as we always try to buy the best for our money, employers like to "shop around" for individuals who will do the best job possible.

INTERVIEW PROCEDURE

Most job interviews are conducted in the following manner. The receptionist greets the applicant in an outer office. After the necessary forms and papers are filled out, the receptionist then takes them in to the interviewer. The reason we mention this seemingly minor detail is because it is usually very important. The opinion of the receptionist concerning the applicant carries a lot of weight with the boss. In other words, be nice to the receptionist.

During a job interview an employer usually guides the conversation by asking significant questions. A friendly atmosphere is created and the applicant responds by carrying on most of the conversation. While the applicant talks the interviewer will be searching for clues to the individual's personal qualities: enthusiasm, initiative, dependability, moral character, ability to get along with others, and capacity to do the work.

PERSONAL INVENTORY

The job applicant is, in effect, attempting to do a selling job - the services he or she can perform for the company. Anyone who has had the opportunity of watching a good salesperson work knows the salesperson has thorough knowledge about the product being sold. Like the successful salesperson, all job applicants should be well acquainted with the products being sold - themselves. In order to gain more thorough knowledge about themselves, job seekers should prepare written personal inven-

tories. This is not done to be presented to the employer, but for the applicant's own study and benefit.

KNOW THE COMPANY

Prior to the interviewer, an applicant should gather as much information about the firm as possible. The location of plants, kinds of products sold or manufactured, types of services rendered, growth trends, and employment opportunities available are some facts that should be helpful during an interview. This information is important regardless of the size of the firm, and a good way to get it is by talking to one of our more of the employees.

THE INTERVIEW

There are some very basic considerations to remember on the day of the interview that will help to make a good impression.

Personal Appearance - The applicant should be neatly dressed but not overdressed for the job being sought. For many jobs, especially those which require the worker to deal with the public, wearing a coat and tie would be fitting. For others, such as a job on a construction site, a coat and tie might be considered overdressed. In any case, the applicant should wear clean, well pressed clothes and shined shoes. The hair should be combed, fingernails cleaned, teeth brushed, and boys should have a shave. The applicant should not smoke unless invited to do so by the prospective employer. One should, at all times, consider oneself a guest in the employer's office and should act accordingly.

Promptness - A good salesperson never keeps the customer waiting and this is a good example for the job applicant. A person who is tardy for a job interview creates a very unfavorable impression.

Exclusion - The applicant should always go alone for the interview. Most employers resent persons applying in groups or pairs, and in many instances the friend or companion has been hired instead of the person who was applying for the job.

IN CONCLUSION

The job applicant should not be too disappointed if unable to make the desired impression on the first try. Make an appointment for an interview with another firm and learn from the mistakes made during the first one. After a "practice trial" the applicant should become more familiar with the procedure and be better able to convey the self-confidence, poise, and maturity that all employers are looking for in employees. After all, even the best salesperson does not make a sale every time.

The following list of questions may help you to better prepare yourself for the interview.

1. Why would you like to work for our company?
2. Are you seeking temporary or permanent employment?
3. In what type of work are you most interested?
4. Do you prefer working by yourself or would you prefer to work with others?
5. What qualifications or training do you have for this job?
6. Where did you rank in your graduating class from high school?
7. Do you feel that you have done the best scholastic work that you are capable of doing?
8. In what activities and clubs were you involved while in high school?
9. How many days were you absent from school or work because of illness?
10. Have you had any serious illness?
11. Do you smoke?
12. Do you drink alcoholic beverages?
13. Do you like routine work?
14. Do you like regular hours of work?
15. How do you feel about working overtime?
16. Do you prefer a specific geographic location?
17. Are you willing to go where the company sends you?
18. What salary do you expect?
19. Have you had any difficulty getting along with fellow students and instructors?
20. Do you have any debts?
21. How do you spend your leisure time?
22. Do you have any other part-time duties?
23. Would you be interested in part-time training to improve your position with the company?
24. What is your major weakness?
25. When can you begin work?

CROSSWORD PUZZLE

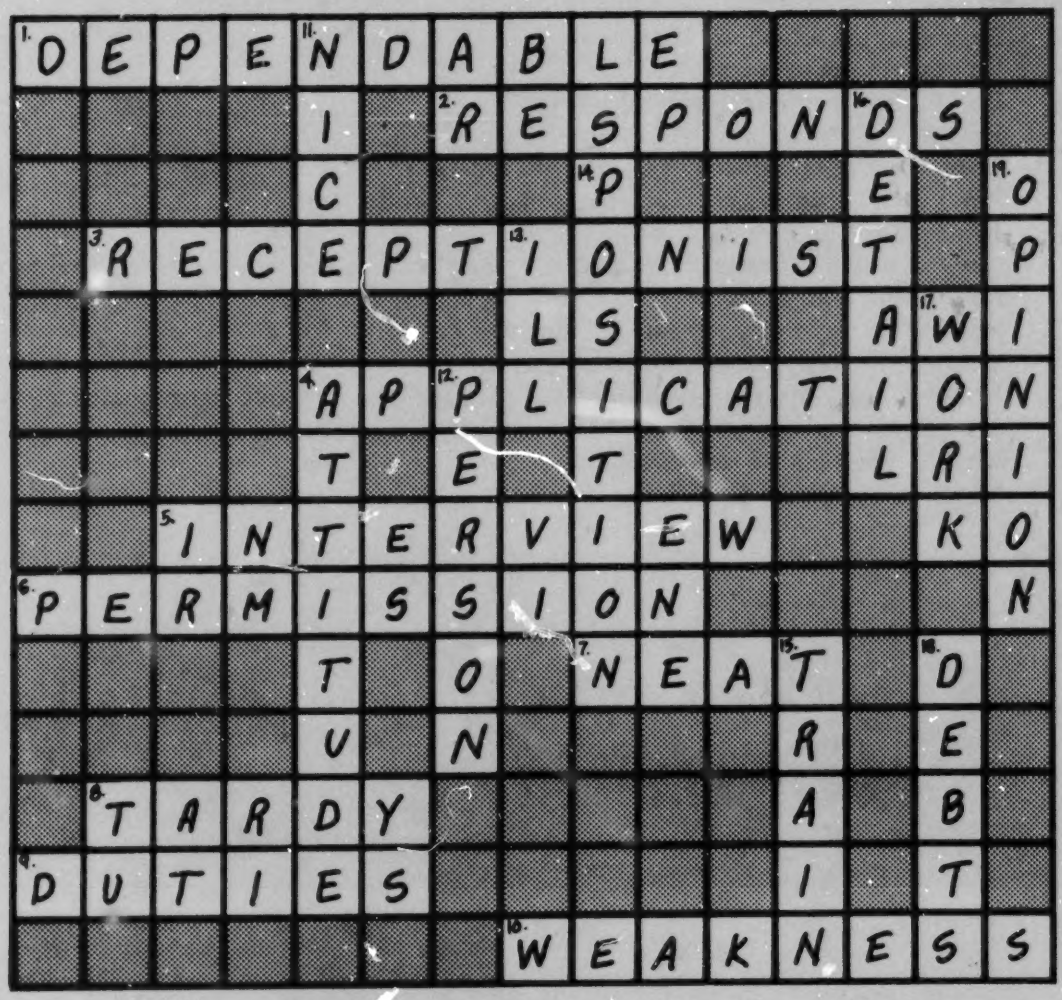
VII-C-1(AS)

ACROSS

1. Can be counted on
2. Reacts
3. Carries weight with boss
4. First step in getting job
5. Face to face encounter
6. Invitation or approval
7. Prim or well dressed
8. Late
9. Job assignments
10. Opposite of strength

DOWN

4. Mental set
11. Being friendly
12. Singular of people
13. Sick
14. Job, place, or posture
15. Either to teach or to learn
16. A very small part
17. Employment
18. Something owed
19. Personal belief



INSTRUCTOR'S PLAN
INFORMATIONAL LESSON

VII-D-1(I)

SUBJECT: Employer - Employee Responsibility

AIM: After completing this lesson the student will be able to describe their responsibilities to an employer and to relate what they should expect in return.

TEACHING AIDS: Information Sheet - Employment Responsibility
Assignment Sheet - Employer - Employee Responsibility
Test Sheet

MATERIALS: None

TOOLS AND EQUIPMENT: None

REFERENCES: Woodburn, Clint H., Development of Professional Attitudes, Vocational Instructional Services, Texas A&M University, F.E. Box 182, College Station, TX 77843

PREREQUISITE EXPERIENCE OF THE LEARNER: None

I. PREPARATION (OF THE LEARNER - MOTIVATION)

There is a great deal more to the relationship between the employer and employee than simply a "day's work for a day's pay." Whether a written contract exists or not there is a bond between the two, and each has responsibilities owed to the other. These responsibilities are the subject of this lesson.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Factors of Success	1. Performance of duties 2. Understanding and knowledge 3. Getting along with people
B. Employer Responsibility	1. Place to work a. Pleasant surroundings b. Comfortable atmosphere c. Space and equipment d. Tools e. Eating facilities 2. Training a. Some pay for college courses b. On-the-job training c. Night courses d. Supervisory training

3. Wages or salary
   a. Social security records
   b. Income tax deductions
   c. Retirement plans
4. Fringe benefits
   a. Health insurance
   b. Unemployment insurance
   c. Paid holidays
   d. Vacations
   e. Discounts

C. Employee Responsibility

1. Honesty
   a. Theft
   b. Day's work for day's pay
   c. Punctuality
2. Loyalty
   a. Support the company
   b. Speak well of employer
   c. Goes both ways
   d. Is very valuable
3. Willing to learn
   a. Company rules and routines
   b. New equipment and methods
   c. More than own tasks
4. Doing without being told
   a. Don't wait to be told
   b. Follow directions
5. Respecting authority
   a. Management has right to command
   b. Power must be respected
6. Getting along with people
   a. Co-workers
   b. Supervisors
   c. May be learned
7. Cooperating
   a. Help other workers
   b. Do the "dirty" jobs
   c. Work as team member
8. Following rules
   a. Rules are necessary
   b. Learn and follow policies
9. Tardiness and absenteeism
   a. Means being late or absent
   b. Are poor work habits
   c. Reduce production
   d. Always call in if sick

10. Terminating employment
    a. Called "due notice"
    b. Based on "unwritten law"
    c. One or two weeks notice
    d. Employer owes it to employee
    e. Employee owes it to employer
    f. Anthing else is poor taste
    g. Can cause haunting work record
11. Performance review
    a. Evaluates worker production
    b. May occur as needed
    c. Workers usually evaluated periodically
    d. Constructive criticism from supervisor
    e. Should be considered helpful
    f. Offers chance to improve

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Employer - Employee Responsibility
2. Check student's answers on assignment sheet
3. Discuss actual cases of people who have lost their jobs due to one or more of the factors mentioned in the information sheet. Caution against using names of people or places of business.

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

1. Ask oral questions
2. Test Sheet - Employment Responsibility
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss test and answer student questions
2. Review major topics of the lesson

THE NEXT LESSON IS: AC Mathematics

The degree of success attained by a worker on the job is largely dependent upon three factors: ability to perform the duties of the job skillfully; possession of the necessary understanding and knowledge; and the ability to get along with people on the job. It seems that skills and knowledge, even though important, cannot overcome the handicap of poor human relations. But by the same token, employers who ignore the principles of good human relations are plagued with disgruntled workers and usually have a high rate of labor turnover. A good employer-employee relationship is truly a two-way street requiring thoughtfulness, consideration and fair play on both sides.

Many new employees take for granted the various benefits provided by the employer. They would do well to understand that the benefits provided by management give them the right to expect something in return. Having the right attitude toward the employer will make the worker more successful on the job and a much more valuable employee. Here are some things an employer usually provides.

1. The employer provides a place to work and equipment to work with. This often includes land, buildings, and fixtures which may require a sizeable investment.

2. Employers usually do not expect new workers to be fully productive until they have been trained for the job. As a general rule, employers lose money on young workers while they are being trained. They may also invest many more dollars in the training of an enterprising worker for a supervisory position.

3. A business provides, as much as possible, pleasant surroundings in which to work. In addition to providing adequate space and equipment, many firms have eating facilities, hobby shops, and recreational activities for their employees.

4. The employer is responsible for salaries and other financial benefits. These may include various forms of insurance (medical, life, accident, and unemployment), advancement, retirement plans, holidays, vacations, discounts on purchases, and the handling of income tax deductions and social security accounts.

Employers have a right to expect cooperation and dependability in return for salaries and other benefits. These may include the following attitudes and characteristics on the part of the employee.

1. Honesty - It is surprising that some people think that "taking just a little" is not being dishonest. They will nonchalantly walk off with a quarter from the cash drawer, a candy bar from the counter, or a small tool or some other item from the tool room. Honesty means more, however, than just not taking things

that do not belong to you. It means giving a fair day's work for a fair day's pay; it means carrying out one's side of a bargain; it means that one's words convey true meanings and actual happenings. Our thoughts as well as our actions should be honest. Nothing brings quicker dismissal and disgrace for an employee than dishonesty. On the other hand, an employer will do much to keep an employee who is strictly honest.

2. Loyalty - Loyalty implies support of a cause, ideal, practice, or custom. It means being for a person or an organization. Between employer and employee it is a two-way proposition. Employees expect employers to look out for their interests, to provide them steady employment, to promote them to better jobs as openings occur. Employers feel that they too have a right to expect employees to be "for" them - to keep their interests in mind, to speak well of them to others, to keep any minor troubles strictly within the plant or office, and to keep absolutely confidential all matters that pertain to the business. Perhaps both employers and employees should keep in mind that loyalty is not something to be demanded; rather, it is something to be deserved.

   Loyalty takes time to mature and grow. It is the product of continued contact with a person or business over a period of time. New employees should not expect to receive this loyalty before proving themselves worthy of their supervisors' faith and confidence. Likewise business firms must earn loyalty from their employees. The good will and loyalty which develop between supervisors and employees are valuable commodities which are not to be treated lightly.

3. Willingness to learn - Almost every firm or business will have its own way of doing things. Employers expect their employees to be willing to learn these ways. Also the installation or use of new equipment or machines makes it necessary for even experienced employees to learn new methods and operations. It will be noted that workers who are promoted to jobs with greater responsibility are usually those who have taken the time and trouble to learn more than just their own daily tasks.

4. Willingness to take responsibility - Most employers expect their employees to see what needs to be done, then go ahead and do it. It is very tiresome to have to ask again and again that a certain job be done. When an employee is given directions about how to do a job, then the individual is expected to follow them exactly. It is generally true that responsibility should be delegated and not assumed. However, once the responsibility has been delegated, the employee should continue to perform the duties without further direction.

5. Respect for authority - Authority in industrial firms usually rests in managerial positions which are responsible for production, sales, or service as the case may be. It is the power or right to give commands, take actions, or make final decisions. Many places of business are small and uncomplicated, but the concept of respecting superiors is important even in the smallest of them.

6. Ability to get along with people - This is perhaps the most highly prized of all employee traits. For many the ability to get along well with people seems to come as a gift. To others it comes only as a result of painstaking thought and training. In order to acquire this ability one must learn to think of others as individuals; to be able to, at times, put oneself in another person's place; and to want sincerely to get along with others. Once acquired, the ability to get along well with people pays big dividends in friendships, popularity, and profits.

7. Willingness to cooperate - The employer who pays the salary has a right to expect full cooperation of the employee. One of the best ways to show a cooperative attitude is to offer to help other employees when one's assigned duties are completed. In many firms there are certain tasks that nobody likes to do. The employee who is willing to do these tasks will make a good impression on the boss and win the cooperation of fellow workers. One should learn to work as a member of a team with the employer, supervisors, and fellow workers. There should be a common effort to get the work done pleasantly and on time.

8. Rules and regulations - Not even two people can work well together unless there is some understanding as to what work shall be done, when it is to be done, and who shall do it. Rules and regulations are a necessity in any work situation. All new employees are expected to familiarize themselves with company policy and to adhere to it when on the job.

9. Tardiness and absenteeism - Tardiness refers to being late for work, and absenteeism means being off the job for one reason or another. Both are poor work habits that lead to reduced production. We are all creatures of habit in that we develop patterns of behavior and stick to them. The habit of being late may start in our early school days and then carry through the school years into our working lives. Developing the habit of getting up a few minutes earlier and doing a little better job of planning the morning schedule will help to break the tardiness habit.

   It is sometimes necessary to take time off from work. No one should be expected to work when sick or when there is serious trouble at home which demands attention. However, it is possible to get into the habit of allowing unimportant and unnecessary matters to keep us from the job. This results in lost production and hardship on those who try to carry on the work with less help. Again there is a principle involved. The person who hires us has a right to expect us to be on the job unless there is some very good reason for staying away. Certainly we should not let some trivial reason keep us home. We should not stay up nights until we are too tired to go to work the next day. If ill, we should do everything we can at home to recover more quickly.

   This brings up another matter about which employers have complained bitterly at times. If you do find it necessary to stay home, then at least telephone the place of business to tell the boss you will not be in. The supervisor can then make arrangements to compensate for your absence.

10. Performance review - There is now coming into use in more and more companies and firms a process called a performance review. Very simply, it is an evaluation of how individuals are performing their assigned duties. If necessary, possibilities of making improvements are suggested. In many larger electronics firms employees go through a period of probation of six months to a year. Their progress is evaluated both during and at the end of this time, and they then become permanent employees or are terminated. Many firms evaluate employee performance once a year and base pay raises on the evaluation. Reviews should be considered "constructive criticism" from the boss or supervisor, and if taken with a positive attitude can help one become a more productive employee. After all, remember that you are all on the same team.

11. Termination of employment - There exists in our present employer-employee relations an "unwritten law". It deals with termination of employer-employee relations. This is called "due notice" to employer by employee, and also "due notice" to employee by employer. Most of our employment today is based on this "unwritten law". Usually from one to two weeks in time, it allows both employer and employee time to make adjustments before termination without jeopardizing either. Simply quitting on a moment's notice, or worse yet not showing up for work, is in very poor taste and shows a lack of maturity. It leaves a work record behind that can "haunt" the individual when looking for a job.

EMPLOYER-EMPLOYEE RESPONSIBILITY VII-D-1(AS)
Key

Name _____ Date _____

Directions: Each student will complete this assignment sheet on an individual basis. Answer the following discussion questions in complete sentences in the spaces provided.

1. Discuss some things an employee can do that they might not consider dishonest but actually are.

A few are: being late for work; taking breaks too long; walking out with small items; wasting time visiting; etc.

2. There is a saying that goes, "Don't bite the hand that feeds you." Restate it as it might apply to this lesson.

Be loyal to your employer.

3. What three things largely determine the degree of success attained by workers on the job?

a. They must have the ability to perform duties skillfully.

b. They must have job knowledge and understanding.

c. They must have the ability to get along with people.

4. What are four things provided by employers in most job situations?

a. They provide a place to work.

b. They provide training on the job.

c. They provide wages or salary and all its record keeping.

d. They provide fringe benefits.

5. What are ten things an employer has a right to expect from an employee?

a. The employer has a right to expect honesty.

b. The employer has a right to expect loyalty.

c. The employer has a right to expect a willingness to learn.

d. The employer has a right to expect a willingness to take responsibility.

e. The employer has a right to expect respect from an employee.

f. The employer has a right to expect the ability to get along with people.

g. The employer has a right to expect cooperation.

h. The employer has a right to expect one to comply to rules.

i. The employer has a right to expect promptness and good attendance.

j. The employer has a right to expect prior notice of termination.

k. The employer has a right to expect a good attitude toward the performance review.

TEST VII-D-1(T)
Key

Name _____ Date _____

Directions: Read the following statements carefully. Some of them are true and some of them are false. Write your answer in the space provided. Check your answers before turning in your paper.

False 1. Human relations can be described as a one-way street.

True 2. Employers would like new employees to be very productive.

False 3. Being disgruntled means an employee is happy.

True 4. Most employers lose money on new employees.

False 5. Salaries and wages are called fringe benefits.

True 6. Employees who want to learn are more valuable than others who do not.

True 7. One must work hard to earn an employer's confidence.

True 8. Newer employees should do dull, boring jobs before anyone tells them to.

True 9. If you are friendly and cooperative on the job, you are considered an asset to the firm.

True 10. The tardiness habit learned in high school often carries over to the job.

False 11. If you have the flu you should go to work and do the best you can.

True 12. A performance review often results in a merit raise.

True 13. Giving constructive criticism means the supervisor is hoping to help the employee become more productive.

False 14. One should call in to terminate employment.

True 15. "Due notice" is a common courtesy that is the responsibility of both employers and employees.

INSTRUCTOR'S PLAN VIII-A-1(I)
INFORMATIONAL LESSON

SUBJECT:	AC Mathematics
AIM:	Upon successful completion of the lesson, the student will be able to demonstrate understanding of trigonometry to solve electronic circuit problems.
TEACHING AIDS:	Chalkboard, overhead projector, Transparency Set 19501, fig. 1-2
MATERIALS:	Information Sheet - Trig Tables Assignment Sheet - AC Mathematics Graph Paper (10 x 10 with 1" grid) Test Sheet - AC Mathematics
TOOLS AND EQUIPMENT:	None
REFERENCE:	Andrews, Electronics Math
PREREQUISITE EXPERIENCE OF THE LEARNER:	Algebra prerequisite

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Trigonometry is a study of the relations between the sides and angles of right triangles. It provides a method of finding the values of the remaining angles and sides of a triangle when certain angles and sides are known. The principle use of trigonometry in electronics is in solving AC circuit problems involving the phase difference between voltage and current and the impedance or total opposition to AC current flow.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Triangles Show Transparency fig. 1	1. All triangles have six elements, three sides and three angles 2. The sum of the angles in a triangle is equal to 180 degrees 3. A triangle in which one of the angles is a right angle (90°) is called a right triangle
B. Triangle Element Names	1. The angles are designated by the capital letters A, B, and C; and the sides by the small letters a, b, and c 2. Side c is opposite angle C and is called the hypotenuse 3. Side b is opposite angle B and is called the adjacent side 4. Side a is opposite angle A and is called the opposite side 5. Angle A is called theta and is represented by the Greek letter θ

C. Pythagorean Theorem

1. For a right triangle, the square of the hypotenuse is equal to the sum of the square of the other two sides
2. Formula: $c^2 = a^2 + b^2$
3. Example problems:
   a. Find the hypotenuse of a triangle with sides of 12 and 23 feet (25.9')
   b. If side b equals 400 and side a equals 350, what does side c equal? (531.5)
   c. If side c equals 740 and side a equals 710, what does side b equal? (209)

D. Trigonometric Functions

1. There are three basic trigonometric functions used in electronics
2. These are ratios that express the relationship between one of the two acute angles in a right triangle and two of the sides
   a. sin θ = opposite/hypotenuse
   b. cos θ = adjacent/hypotenuse
   c. tan θ = opposite/hypotenuse
3. Example problems:
   a. Find the sin of θ if the hypotenuse equals 6 and the opposite side equals 3 (0.5000 30 degrees)
   b. Find the sin of θ if the opposite side equals 700 and the hypotenuse equals 900 (0.7778 51 degrees)
   c. Find the cosine of θ if the adjacent side equals 106 and the hypotenuse equals 200 (0.5300 58 degrees)
   d. Find the cosine of θ if the adjacent side equals 156 and the hypotenuse equals 175 (0.8914 26.9 degrees)
   e. Find the tangent of θ if the opposite side equals 14 and the adjacent side equals 23 (0.6087 31.3 degrees)
   f. Find the tangent of θ if the opposite side equals 23 and the adjacent side equals 14 (1.643 58.7 degrees)

E. Trig Tables
Show Transparency fig. 2

1. Trig tables are a listing of ratios and the specific angles of theta represented by the ratio
2. The table is divided into sin, cos and tan sections
3. The columns are divided into angles and minutes or parts of angles
4. Find the ratio in the column under the appropriate function. The corresponding angle can be read from the right hand column

5. Examples - find theta if:
   a. sin θ = .5000 (30° 0')
   b. sin θ = .9232 (67° 24')
   c. cos θ = .9563 (17° 0')
   d. cos θ = .4003 (66° 24')
   e. tan θ = .7002 (35° 0')
   f. tan θ = 17.89 (86° 48')

F. Vectors

1. In order to express some quantities completely, it is necessary to express their directions as well as their magnitude. This is done by means of a straight line called a vector
2. Phasors are rotating vectors used to study AC circuits
3. Vector addition
   a. Vectors in the same direction are added together to get their total resultant magnitude
   b. Vectors in opposite directions are subtracted to get their total resultant magnitude
   c. Vectors in various directions can be solved by graphing

III. APPLICATION, DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - AC Mathematics
2. Check each student's work for completeness and accuracy
3. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

1. Ask oral questions
2. Test Sheet - AC Mathematics
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: RLC Circuits

RIGHT TRIANGLE

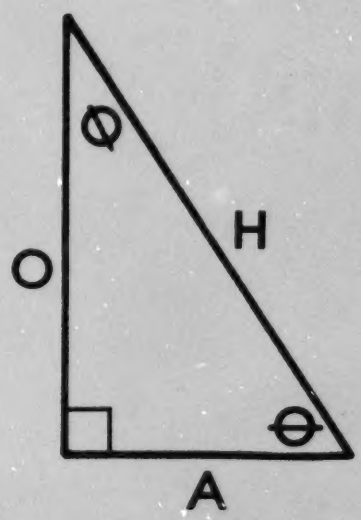
PYTHAGOREAN THEOREM

$$c^2 = a^2 + b^2$$

TRIGONOMETRIC FUNCTIONS

$$\text{SIN}\Theta = \frac{\text{Opposite}}{\text{Hypotenuse}} \qquad \text{COS}\Theta = \frac{\text{Adjacent}}{\text{Hypotenuse}}$$

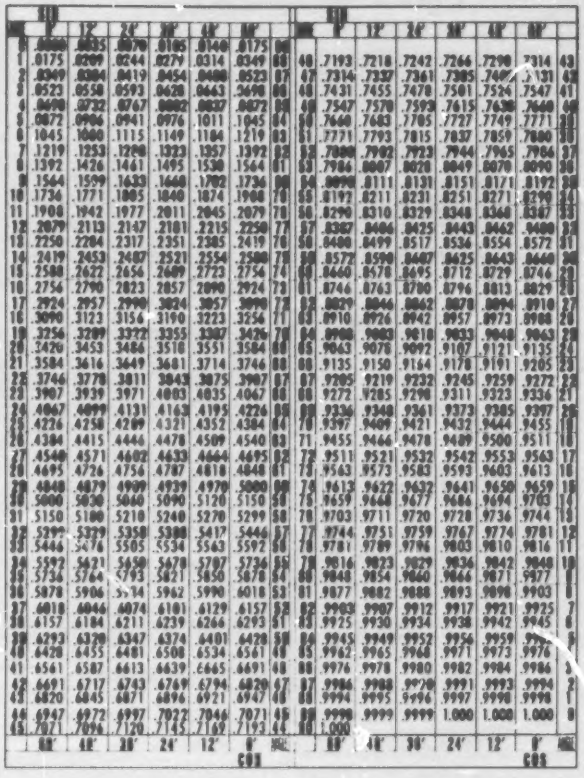
$$\text{TAN}\Theta = \frac{\text{Opposite}}{\text{Adjacent}}$$

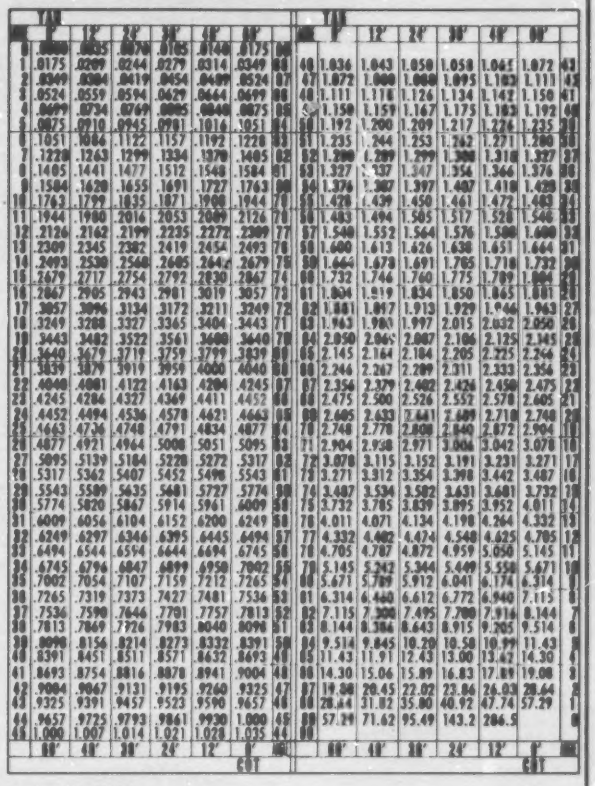


H = Hypotenuse Side
A = Adjacent Side
O = Opposite Side
Θ = Angle Theta
Ø = Angle Phi

Tables and Formulas

Trigonometric Functions





Four-place Logarithms

N	0	1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396
	0	1	2	3	4	5	6	7	8	9

N	0	1	2	3	4	5	6	7	8	9
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996
	0	1	2	3	4	5	6	7	8	9

BEST COPY AVAILABLE

Name _____ Date _____

Directions: This assignment sheet is to be completed on an individual basis. Solve the following problems using the Pythagorean Theorem method. Show all work on a work sheet and write your answers in the space provided. Round off your answers to three significant figures. If you have any questions, ask your instructor.

3.61 1. a = 2 & b = 3, c = ___
30.9 2. a = 28 & b = 13, c = ___
27.3 3. a = 4 & b = 27, c = ___
4.04 4. b = 27 & c = 27.3, a = ___
16.1 5. b = 14 & c = 21.3, a = ___
246 6. b = 683 & c = 726, a = ___
43.0 7. a = 18 & c = 46.6, b = ___
63.0 8. a = 33 & c = 71.1, b = ___
418 9. a = 357 & c = 549.7, b = ___
633 10. a = 632 & b = 28, c = ___

Directions: Interpret your Trig function table for the indicated function and angle. Write your answer in the space provided. Do not round off your answers. If you have any questions, ask your instructor.

11. sin 21.0°= .3584
12. sin 48.1°= .7443
13. cos 28.5°= .8788
14. cos 27.0°= .8910
15. tan 45.0°= 1.000
16. tan 26.3°= .49425
17. cos 1.0°= .9998
18. cos 37.6°= .6101
19. cos 28.6°= .8780
20. cos 89.9°= .00175
21. sin 26.3°= .44305
22. sin 63.0°= .8910
23. cos 43.8°= .7218
24. cos 18.8°= .9466
25. tan 72.4°= 3.152
26. sin 45.0°= .7071
27. sin 1.0°= .0175
28. cos 79.4°= .1840
29. tan 25.2°= .4706
30. tan 89.0°= 57.29
31. sin 42.7°= .67815
32. sin 28.5°= .47715
33. cos 52.3°= .6115
34. cos 26.3°= .8965
35. tan 15.2°= .2717
36. cos 45.0°= .7071
37. sin 30.0°= .5000
38. tan 69.0°= 2.605
39. sin 89.9°= 1.000
40. tan 48.4°= 1.126

Directions: Interpret your table for the angle represented by the following functions. Use decimal fractions for parts of angles. Ex. 16.5°.

41. sin 15.0° =.2588
42. cos 60.0° =.5000
43. tan 86.6° =16.83
44. sin 61.6° =.8796
45. cos 10.4° =.9836
46. cos 17.4° =.9542
47. sin 11.6° =.2011
48. tan 83.0° =8.144
49. sin 88.8-89°=.9998
50. sin 0.40° =.0070
51. tan 74.6° =3.631
52. tan 8.6° =.1512
53. cos 40.6° =.7593
54. sin 64.6° =.9033
55. sin 56.0° =.8290

Directions: Solve the following problems using Trigonometric functions. Show all your work on a work sheet. Round off your answers to three significant figures and write them in the space provided. If you have any questions, ask your instructor.

.800 1. If the opposite side of a right triangle equals 100 and the hypotenuse equals 125, then sin θ equals _____.

53.1° 2. In question 1, θ = _____.

.600 3. If the hypotenuse of a right triangle equals 50 and the opposite side equals 30, then sin θ equals _____.

36.9° 4. In question 3, θ = _____.

37.2 5. If the opposite side of a right triangle equals 25 and sin θ equals .6717, then the hypotenuse equals _____.

42.2° 6. In question 5, θ = _____.

272 7. If the hypotenuse of a right triangle equals 600 and θ equals 27 degrees, then the opposite side equals _____.

300 8. If the opposite side of a right triangle equals 150 and θ equals 30 degrees, then the hypotenuse will equal _____.

62.8 9. If the hypotenuse of a right triangle equals 65 and θ equals 75 degrees, then the opposite side will equal _____.

51.0 10. If the opposite side of a right triangle equals 45 and θ equals 62 degrees, then the hypotenuse equals _____.

.750 11. If the adjacent side of a right triangle equals 75 and the hypotenuse equals 100, then cos θ equals _____.

41.4° 12. In question 11, θ = _____.

.259 13. If the hypotenuse of a right triangle equals 58 and the adjacent side equals 15, then cos θ equals _____.

75.0° 14. In question 13, θ = _____.

240 15. If the hypotenuse of a right triangle equals 350 and θ equals 46.6 degrees, then the adjacent side equals _____.

4 160 16. If the adjacent side of a right triangle equals 4,000 and θ equals 15.8 degrees, then the hypotenuse equals _____.

2.00 17. If the adjacent side of a right triangle equals 15 and the opposite side equals 30, then tan θ equals _____.

63.4° 18. In question 17, θ = _____.

7.00 19. If the opposite side of a right triangle equals 35 and the adjacent side equals 5, then tan θ equals _____.

81.9° 20. In question 19, θ = _____.

TEST
AC MATHEMATICS

VIII-A-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Select the word or words which best completes the statement and write them in the space provided. Be sure to check your answers. For questions 1 - 6, identify the parts of the triangle in figure 1 by name.

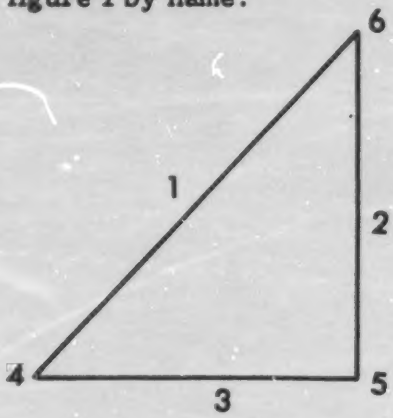


figure 1

Hypotenuse 1.

Opposite 2.

Adjacent 3.

Theta θ 4.

Right Angle 90° 5.

Phi Ø 6.

Trigonometry 7. ____ gives us methods and procedures for calculating the lengths of the sides and the angles of a triangle.

90 8. A right triangle is a three-sided geometric figure that has one angle of _____ degrees.

180 9. The sum of the three angles in any triangle is always ____ degrees.

Vector 10. Quantities which have direction as well as magnitude are called _____ quantities.

Sin θ 11. The trig function _____ can be found by dividing side 2 by side 1 in figure 1.

Tan θ 12. The trig function ____ can be found by dividing side 2 by side 3 in figure 1.

Cos θ 13. The trig function ____ can be found by dividing side 3 by side 1 in figure 1.

41.8° 14. In figure 1, if side 1 is 450 and side 2 is 300 then 4 will be _____.

57.6° 15. In figure 1, if side 1 is 28 and side 3 is 15 then 4 will be ____.

90.0° 16. In figure 1, if side 1 is 156.5 and side 3 is 27.5 then 5 will be _____.

16.8° 17. In figure 1, if side 1 is 36 and 4 is 27.8 degrees then side 2 will be _____.

63.0° 18. In figure 1, if side 3 is 54 and 6 is 27 degrees then 4 will be _____.

1.88 19. In figure 1, if 1 is 8 and 4 is 13.6 degrees then 2 will be ____.

11.2 20. In figure 1, if 1 is 15 and 2 is 10, then 3 will be _____.

INSTRUCTOR'S PLAN
INFORMATIONAL LESSON

VIII-B-1(I)

SUBJECT:	R-L-C Circuits
AIM:	Upon successful completion of the lesson, the student will be able to demonstrate understanding of RLC circuits by analyzing circuits, making calculations and answering questions.
TEACHING AIDS:	Chalkboard, overhead projector, Transparency Set 19501, figs. 3-5 Assignment Sheet - R-L-C Circuits Test Sheet - R-L-C Circuits
TOOLS AND EQUIPMENT:	Student lab station Component set
REFERENCES:	Fowler, Electricity - Principles and Applications Grob, Basic Electronics
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

We have studied how capacitors and resistors function together in a circuit. In another unit we studied how inductors and resistors function together in a circuit. In this lesson we will learn how resistors, capacitors and inductors when combined in an R-L-C circuit function. Included will be the impedance or the total opposition to alternating current. We will also analyze the circuit values using vector addition due to the phase difference present.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENT TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Voltage in Series RC Circuits	1. Current is the same through both X_L and R because they are in series 2. Each has its own voltage drop due to $E = IR$ and $E = I X_L$
Show Transparency fig. 3	3. The voltage drop across the capacitor lags the current through the capacitor by 90° 4. There is no phase shift between the voltage and current in the resistance 5. Because of the 90° phase shift between voltage and current in the capacitor, the series voltages must be added by vector addition

B. Impedance in Series RC Circuits

Show Transparency fig. 4

1. The voltage triangle corresponds to the impedance triangle because the current is the common factor in the circuit
2. Formula: $Z^2 = R^2 + X_C^2$
3. Formula: $Z = E_T / I_T$

C. Phase Angle in Series RC Circuits

1. Phase angle between the source voltage and the series current is equal to theta
2. With series X_C, phase angle is negative

D. Current in Parallel RC Circuits

Show Transparency fig. 5

1. No phase difference between the voltage across the source, the resistance, or the reactance
2. Each branch has its current value
3. The current in each branch is out of phase by 90°
4. Due to phase shift, vector addition must be used
5. Formula: $I_T 2 = I_R 2 + I_C 2$

E. Impedance is Parallel RC Circuits

1. Impedance equals the applied voltage divided by the total current
2. Formula: $Z = E_T / I_T$

F. Phase Angle

1. The phase angle is between the total current and the source voltage
2. The phase of E_T is the same as the phase of I_R and theta is between I_T and I_R
3. Formula: $\tan \theta = I_C / I_R$

G. Voltage in Series RL Circuits

1. The current is the same through the reactance and the resistance
2. Each has its own series voltage drop due
3. The voltage drop across the inductor leads the current by 90°
4. The current through the resistance is in phase with the voltage across it
5. Due to the phase shift, the voltages must be added with vector addition

H. Impedance in Series RL Circuits

1. The voltage triangle corresponds to the impedance triangle because the current is the common factor
2. Ohm's Law applies for totals: $Z = E_T / I_T$

I. Phase Angle
1. The angle between the source voltage and the series circuit current is the phase angle
2. In circuit with series X_L, the phase angle is positive

J. Current in Parallel RL Circuit
1. There is no phase difference between the voltage across the source, the resistance and the reactance
2. Each branch has its individual current
3. The current in the resistive branch is out of phase with the inductive branch, they must be added by vector addition
4. Formula: $I_T^2 = I_R^2 + I_L^2$

K. Impedance in Parallel RL Circuits
1. Impedance equals the applied voltage divided by the total circuit current
2. Formula: $Z = E_T / I_T$

L. Phase Angle in a Parallel Circuit
1. The phase angle is between the total current and the source voltage
2. The phase of E_T is the same as the phase of I_R and theta is also between I_T and I_R
3. Formula: $\tan \theta = I_L / I_R$

M. Impedance in RLC Circuits
1. Add all resistances to find total R, all X_C to find total X_C and all X_L to find total X_L
2. Subtract X_C from X_L due to the phase shift in opposite directions. The The result is one net reactance, X
3. Net reactance may be either capacitive or inductive
4. Total R and total X can be added by vector addition
5. Formula: $Z^2 = R^2 + (X_L - X_C)^2$

N. Current in RLC Circuit
1. Current is the same throughout a series circuit
2. Use Ohm's Law to find the current in a circuit
3. Formula: $I_T = E_T / Z$

O. Voltage in RLC Circuit
1. All the components in a series circuit have the same current through them
2. Use Ohm's Law to find each voltage drop
3. The net reactive voltage and E_R must be combined by vector addition

P.	Phase Angle in RLC Circuit	1. The phase angle of the series circuit is between X and R 2. Formula: $\tan \theta = X / R$
Q.	Current in Parallel RLC Circuit	1. The voltage is the same throughout a parallel circuit 2. Calculate individual branch currents using Ohm's Law 3. To find I_T, the branch currents must be combined by vector addition 4. Formula: $I_T^2 = I_R^2 + (I_{XL} - I_{XC})^2$
R.	Impedance	1. Impedance is found using Ohm's Law 2. Formula: $Z = E_T / I_T$
S.	Angle Phase	1. Phase angle is found from the branch currents 2. Formula: $\tan \theta = I_X / I_R$
T.	Series-Parallel RLC Circuits	1. Complex circuits are reduced to a single impedance in the same manner as series-parallel resistive circuits 2. Follow the rules for series and parallel RLC circuits when reducing circuits
U.	Real Power in RLC Circuits	1. Due to phase shift, real power is not $P = IE$ 2. All the power is dissipated by the resistive component 3. Formula: $P_{(real)} = I^2R$ 4. Formula: $P_{(real)} = I E \cos \theta$
V.	Power Factor	1. Cos θ represents the resistive components in the circuit 2. Cos θ is the power factor 3. Formula: $Pf = \cos \theta = R / Z$ 4. Power factor is a numerical ratio between 0 and 1 5. It is not an angle
W.	Apparent power	1. When voltage and current are out of phase, $P = IE$ is apparent power 2. The unit of apparent power is the volt-ampere (EA) 3. The unit of Watts is reserved for real power

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - R-L-C Circuits
2. Check each student's work for completeness and accuracy
3. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

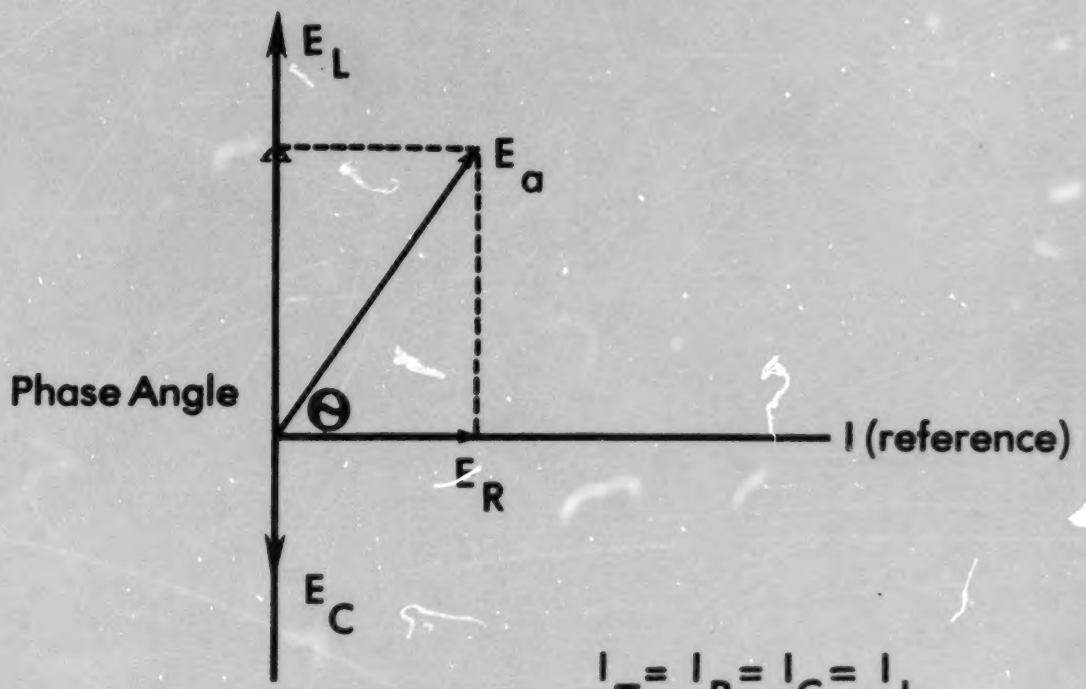
1. Ask oral questions
2. Test Sheet - R-L-C Circuits
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

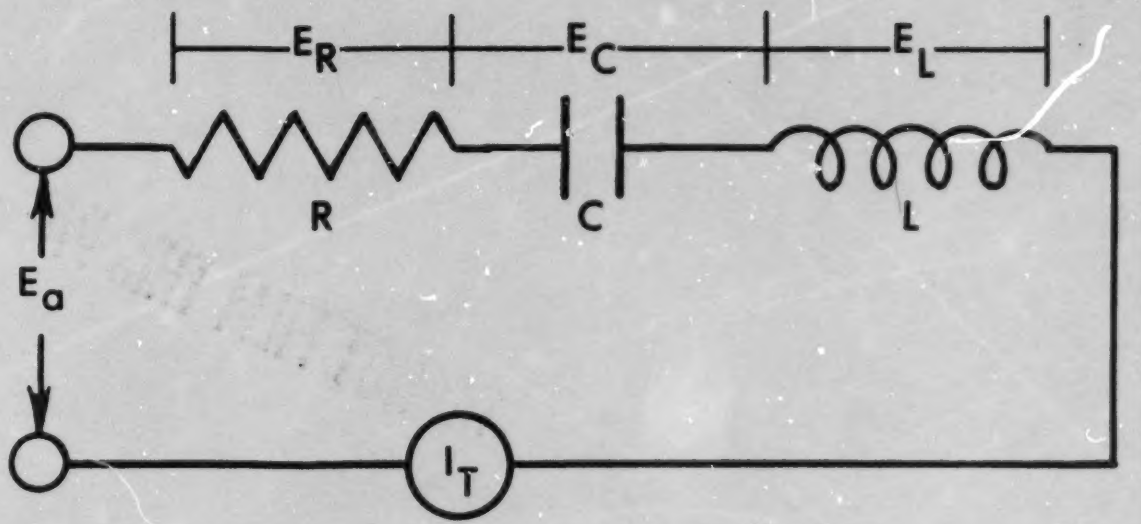
1. Discuss test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Semiconductor Fundamentals

Voltage in Series RLC Circuit



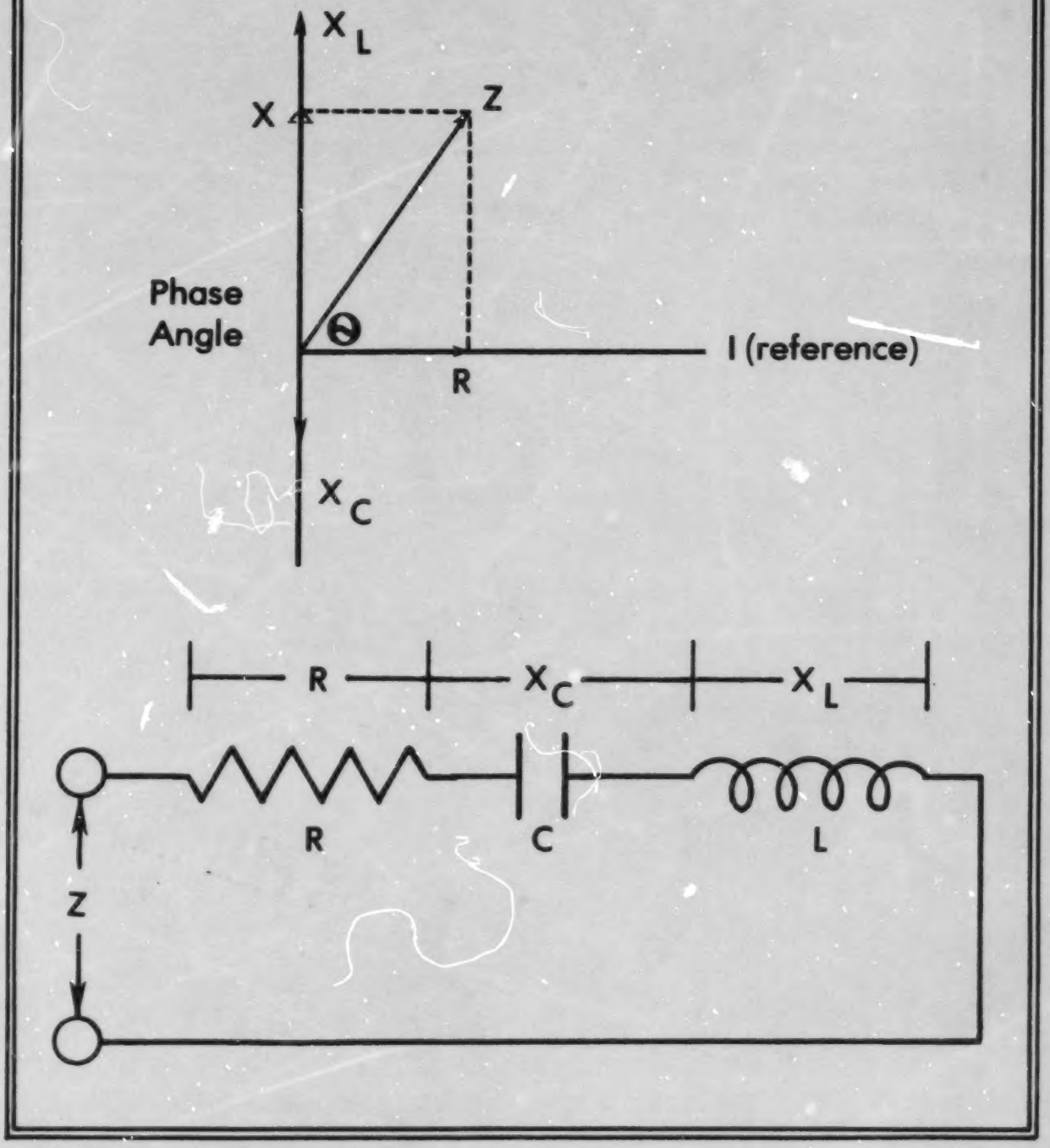
$$I_T = I_R = I_C = I_L$$



19501

fig. 3

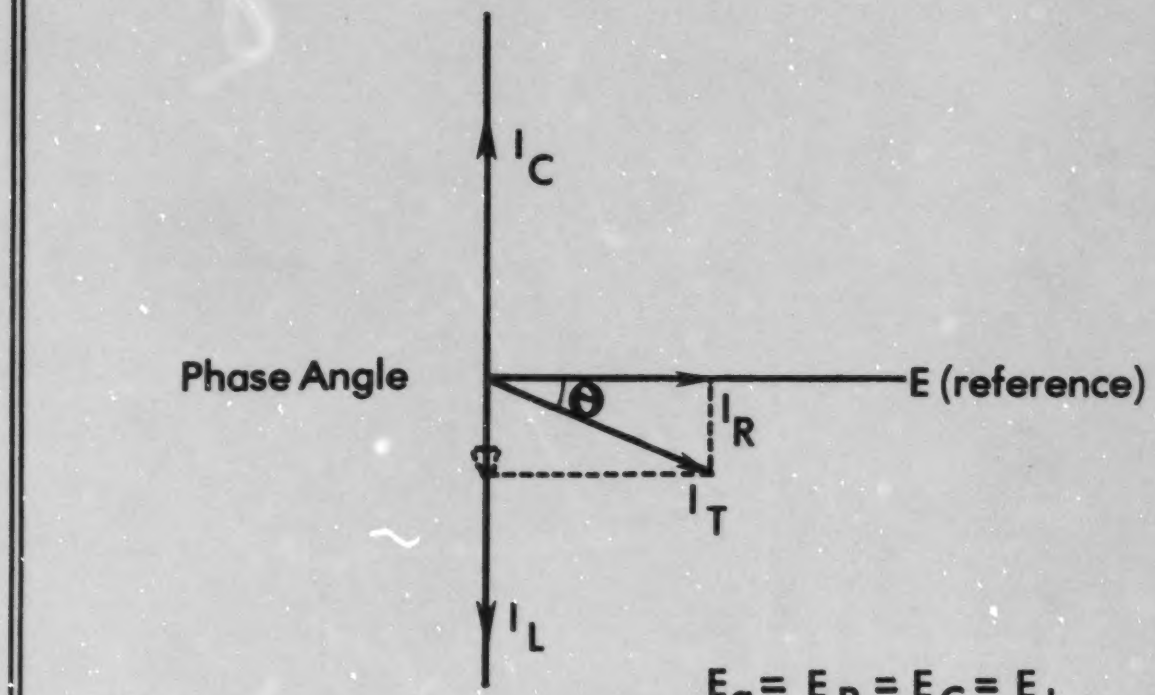
Impedance in Series RLC Circuit



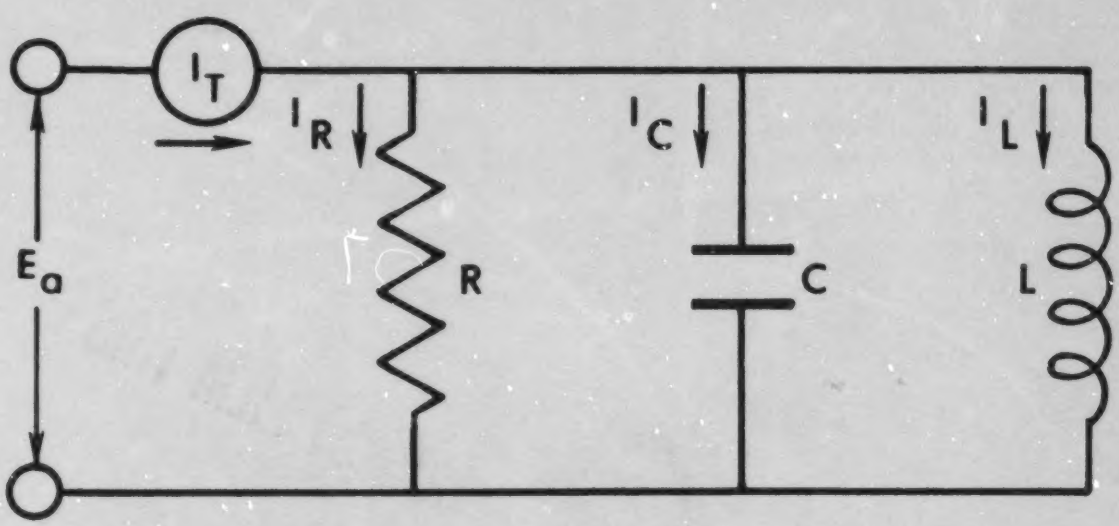
19501

fig. 4

Current in Parallel RLC Circuit



$$E_a = E_R = E_C = E_L$$



Name _____ Date _____

Directions: Read each statement carefully. Round off your answers to three significant figures and write them in the space provided. Be sure to check your answers. If you have any questions, ask your instructor.

50.0 Ohms
1. A 40 Ohm resistance is in series with a 30 Ohm capacitive reactance across a 100 V sine wave source. What is the impedance of the circuit?

2.00 A
2. What is the current drawn from the source in the circuit in question #1?

80.0 V
3. What is the voltage across the resistor in question #1?

60.0 V
4. What is the voltage across the capacitor in question #1?

39.9 degrees
5. What is the phase angle in the circuit in question #1?

4.16 A
6. A 40 Ohm resistance and a 30 Ohm capacitive reactance are in parallel across a 100 Volt sine wave AC source. What is total circuit current flow in the circuit?

2.50 A
7. What is the current flow through the resistance in question #6?

3.33 A
8. What is the current flow through the capacitive branch in question #6?

24.0 Ohms
9. What is the impedance of the circuit in question #6?

53.2 degrees
10. What is the phase angle in the circuit in question #6?

100 Ohms
11. A resistance of 100 Ohms and an inductive reactance of 1.00 Ohm are in series across a 100 V sine wave AC source. What is the impedance of the circuit?

1.00 A
12. What is the total circuit current in the circuit in question #11?

100 V
13. What is the voltage across the resistor in question #11?

1.00 V
14. What is the voltage across the inductor in question #11?

0.573 degrees
15. What is the phase angle in the circuit in question #11?

2.00 A

16. A 50 Ohm resistance and a 50 Ohm inductive reactance are in parallel across a 100 V sine wave AC source. What is the current through the resistance?

2.00 A

17. What is the current through the inductance in question #16?

2.83 A

18. What is the total circuit current in question #16?

35.3 Ohms

19. What is the impedance of the circuit in question #16?

50.0 V

20. A resistance and an inductance are connected in series. If the voltage across the resistance is 30 V and the voltage across the inductance is 40 V, the total applied voltage is _____.

40.0 V

21. In a series AC circuit, 2 A of current flows through a 20 Ohm resistance, a 40 Ohm inductive reactance and a 60 Ohm capacitive reactance. What is the voltage drop across the resistor?

80.0 V

22. What is the voltage drop across the inductor in question #21?

120 V

23. What is the voltage drop across the capacitor in question #21?

28.3 Ohms

24. What is the impedance of the circuit in question #21?

45.0 degrees

25. What is the phase angle of the circuit in question #21?

TEST
R-L-C CIRCUITS

VIII-B-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Each has four possible answers lettered A, B, C, and D. Write the letter representing the best answer in the space provided. Be sure to check your answers.

A 1. The unit of measure for impedance is the ____.
A. Ohm B. Henry C. Ampere D. Farad

D 2. When an inductor has 6 Ohms of resistance and 8 Ohms of reactance is across 120 VAC, current flow through the circuit is _____.
A. 8.6 A B. 35 A C. 10 A D. 12 A

B 3. The phase angle is _____ degrees if the resistance in a circuit is 90 Ohms and the capacitive reactance is 90 Ohms.
A. 90 B. 45 C. 0 D. 180

D 4. The impedance of a 1000 Ohm resistor in series with a 1000 Ohm inductive reactance equals ____ Ohms.
A. 500 B. 707 C. 1 K D. 1.4 K

A 5. The power factor of an AC circuit equals
A. the cosine of the phase angle.
B. zero.
C. current times voltage.
D. one if the resistance is zero.

C 6. If 2 A of current is flowing in the resistive branch and 2 A is flowing in the inductive branch of a parallel circuit, the supply current is _____.
A. 1.00 A B. 2.00 A C. 2.80 A D. 4.00 A

B 7. The power dissipated in a series RC circuit with 10 Ohms of resistance and 10 Ohms of capacitive reactance having an effective current flow of 3 A is _____.
A. 30 W B. 90 W C. 42.4 W D. 127 W

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Answers to calculations should have three significant figures and written using the proper metrix prefix. Be sure to check your answers.

583 Ohms

8. A 500 Ohm resistance is in series with a 300 Ohm capacitive reactance. What is the impedance of the circuit?

583 Ohms

9. A 300 Ohm resistance is in series with a 500 Ohm inductive reactance. What is the impedance of the circuit?

40.0 V

10. In a series AC circuit, 2.00 A of current flows through a 20 Ohm resistance, a 40 Ohm inductive reactance and a 60 Ohm capacitive reactance. What is the voltage across the resistor?

80.0 V

11. What is the voltage drop across the inductor in question #10?

120 V

12. What is the voltage drop across the capacitor in question #10?

56.6 V

13. What is the source voltage in question #10?

28.3 Ohms

14. What is the impedance of the circuit in question #10?

45.0 degrees

15. What is the phase angle in the circuit in question #10?

INSTRUCTOR'S PLAN
INFORMATIONAL LESSON

IX-A-1(I)

SUBJECT:	Semiconductors
AIM:	Upon successful completion of the lesson, the student will be able to demonstrate an understanding of semiconductor materials, current conduction and the advantages of using semiconductor devices by defining terms and answering questions.
TEACHING AIDS:	Chalkboard
MATERIALS:	Assignment Sheet - Semiconductors Test Sheet - Semiconductors
TOOLS AND EQUIPMENT:	None
REFERENCE:	Schuler, Electronics-Principles and Applications
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

In this lesson, you will be studying the properties of semiconductor materials. These materials do not fit into the areas of conductors or insulators. They form a unique group that allows current to flow in a manner that differs from typical conductors. Semiconductor materials are used to produce electronic devices that are more efficient and smaller than earlier devices. The transistor, diode and integrated circuit have allowed the electronics engineer and technician to develop equipment never before possible.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Background	1. History a. Transistor discovered in 1947 at Bell Telephone Laboratories b. Scientists: Bardeen, Brittain and Shockley c. Transistors became widely used during the 1950's d. Integrated circuits developed in 1958 by Texas Instruments 2. Analog and digital a. Electronics field divided into two major sections based on the type of signal processed b. Semiconductor devices are also divided into these areas

c. Analog circuits can have an unlimited number of voltage values
d. Digital circuits usually have only two voltage levels

3. Advantages
   a. Low cost
   b. More efficient
   c. Small size
   d. More reliable
4. Trends
   a. Semiconductor devices are used throughout the world
   b. Modern components are highly specialized and used in many different applications
   c. Most components are designed to operate with analog or digital signals but not both
   d. Many analog systems are now being converted to digital
   e. New devices are placed on the market almost daily

B. Conductors

1. Valence electrons can more from one atom to another and serve as the current carriers
2. Good conductors have a large number of these valence electrons that can be moved
3. Copper, silver and gold are some of the better conductors
4. A good conductor offers very little opposition to current flow
5. Conductors have a positive temperature coefficient, the resistance increases as the temperature increases

C. Semiconductors

1. Materials
   a. Silicon is the most common used
   b. Germanium is also commonly used
   c. Valence orbits have four electrons
   d. Atoms will share valence electrons through covalent bonding
   e. Pure semiconductor materials are poor conductors
   f. Semiconductor materials have a negative temperature coefficient
2. N-Type semiconductors
   a. Pure semiconductors are poor conductors
   b. Impurities are added to change their electrical characteristics
   c. Doping is the process of adding impurities

d. Silicon is doped with arsenic to lower its resistance
e. This results in a free electron in the crystal structure
f. Placing a voltage across N-Type material will result in the electrons moving towards the positive terminal

3. P-Type semiconductors
   a. Doping with boron produces a lack of valence electrons
   b. This lack results in a "hole" in the crystal structure
   c. The hole serves as a current carrier
   d. Hole current is equal to but in the opposite direction from electron current flow
   e. Placing a voltage across P-Type material will result in the holes moving towards the negative terminal as electrons move towards the positive terminal
4. Majority and minority carriers
   a. N-Type material
      1.) Majority carrier is the free electrons
      2.) Minority carrier is the holes
   b. P-Type materials
      1.) Minority carrier is the free electrons
      2.) Majority carrier is the holes

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Semiconductors
2. Check each student's work for accuracy and completeness
3. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

1. Ask oral questions
2. Test Sheet - Semiconductors
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss the test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Diodes

SEMICONDUCTORS IX-A-1(AS)
Key

Name _____ Date _____

Directions: Each student will complete this assignment sheet on an individual basis. Read each statement carefully and place the correct answer in the space provided. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

Solid state
1. Components made from semiconductor materials are sometimes called _____ components.

True
2. Transistors are more reliable and are more efficient than vacuum tubes. (True/False)

Semiconductor
3. Most modern electronic equipment utilizes _____ components.

More efficient
4. List three advantages of semiconductor components over vacuum tubes.

Small size
5.

More reliable
6.

Transistors
7. The two basic semiconductor devices are diodes and _____.

Integrated circuit
8. The most sophisticated solid-state device is the _____.

Germanium
9. Silicon and _____ are the two common semiconductor materials used to manufacture components.

Valence
10. Electrons in the outer shell of an atom are referred to as _____ electrons.

Covalent
11. Semiconductor materials share valence electrons by forming _____ bonds.

Intrinsic
12. Pure semiconductor materials are called _____ materials.

False
13. Electrons and holes move in the same direction through semiconductor materials. (True/False)

Doping
14. Adding impurities to pure semiconductor materials is called _____.

Negative 15. Semiconductor materials have a _____ temperature coefficient.

Arsenic 16. Boron and _____ are used to change the characteristics of semiconductor materials.

Electrons 17. The majority current carriers in N-Type semiconductor materials are _____.

Holes 18. The majority current carriers in P-Type semiconductor materials are _____.

Can 19. Transistors _____ (can/cannot) be made from germanium crystals.

False 20. Solid state devices will soon be replaced by vacuum tube. (True/False)

TEST IX-A-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Place the word or words which best completes the statement in the space provided. Be sure you use correct spelling and check your answers.

Negative 1. Semiconductor materials have a _____ temperature coefficient.

Doping 2. By _____ a semiconductor materials, changes in its electrical characteristics are made.

Holes 3. Majority carriers for P-Type semiconductor materials are _____.

Germanium 4. _____ semiconductor material is more sensitive to heat damage than other semiconductor materials.

Electrons 5. The majority carriers in N-Type semiconductor materials are ___.

Intrinsic 6. Pure semiconductor materials are called ____ materials.

Valence 7. The outermost electron orbit of an atom is called the _____ shell.

Low cost 8. List four advantages of semiconductor devices.

Efficient 9.

Small size 10.

Reliable 11.

Digital 12. A/an ____ circuit only has two voltage values.

Analog 13. A/an _____ circuit can have an infinite number of voltage values.

Integrated circuit 14. An advanced and complex solid state device is the _____.

False 15. Semiconductor devices are made from pure semiconductor materials. (True/False)

INSTRUCTOR'S PLAN
INFORMATIONAL LESSON

IX-B-1(I)

SUBJECT:	Diodes
AIM:	Upon successful completion of the lesson, the student will be able to describe the characteristics, applications, and construction of the common types of semiconductor diodes, interpret the forward and reverse bias characteristic curves, identify common diode packages, test diodes, and determine the anode and cathode leads using an ohmmeter.
TEACHING AIDS:	Chalkboard, overhead projector, Transparency Set 19501 figs. 6-10
MATERIALS:	Assignment Sheet - Diodes Task Sheet - Diode Testing Lab Experiment #40 - Semiconductor Diodes Lab Experiment #44 - Zener Diodes Test Sheet - Diodes
TOOLS AND EQUIPMENT:	Student lab station Miscellaneous diodes, VOM
REFERENCE:	Schuler, Electronics-Principles and Applications
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

In this lesson, you will become familiar with the diode which is the most basic semiconductor component. The diode may also be the most common and widely used. Every area of electronics uses diodes. This requires all persons working in the field to have a solid understanding of them. An understanding of diodes will help you to understand the more complex components later. We will cover the characteristics, applications, construction, and testing.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. PN Junction Diode Show Transparency fig. 6	1. A section of P-Type and a section of N-Type in a single piece of semiconductor material 2. Can be either silicon or germanium 3. Junction formed where one type material ends and the other begins 4. Depletion region formed around the junction due to the lack of current carriers

5. Barrier potential is formed across the depletion region which keeps all the electrons from crossing the junction
   a. Barrier potential for silicon is 0.6 to 0.7 Volt
   b. Barrier potential for germanium is 0.2 to 0.3 Volt

Show Transparency fig. 7

6. Forward bias
   a. Voltage applied which turns on a device
   b. Applying negative potential to the N-Type and positive to the P-Type
   c. Causes the depletion region to collapse
   d. Must overcome the barrier potential
7. Reverse bias
   a. Voltage applied which turns off a device
   b. Applying negative potential to the P-Type and positive to the N-Type
   c. Causes depletion to widen
   d. Will cause a small leakage current to flow
   e. Breakdown occurs when the reverse bias is too high

B. Voltage-Current Characteristic Curve

1. Graph showing the amount of current flow for various values of bias

Show Transparency fig. 8

2. Diodes are non-linear devices
3. Shows reverse breakdown point (Avalanche point)
4. Shows conduction under forward bias condition
5. Peak Inverse Voltage (PIV) rating is for maximum reverse bias voltage without destroying the diode
6. Current rating is the maximum current under forward bias condition without destroying the diode

C. Diode Packaging

1. Schematic symbol
   a. Bar end is the cathode (N-Type material)
   b. Triangle end is the anode (P-Type material)
2. Silicon and germanium types
   a. Glass - small with cathode end, usually used for small signal diodes
   b. Plastic - various shapes with cathode end marked
   c. Metal - "top-hat" shape with cathode end marked
   d. Stud mount - high current, can be bolted to heat sink

D. Diode Testing

1. Ohmmeter test to determine direction of forward current
2. Connect negative ohmmeter lead to diode and positive lead to the other end
3. Determine the resistance
4. Reverse ohmmeter leads
5. Determine resistance
6. Compare the two resistance readings
   a. High ratio between equals good diode
   b. Low ratio or the same value equals bad diode
   c. Under low resistance condition, the negative ohmmeter lead is connected to the cathode

E. Other Diodes

Show Transparency fig. 9

1. Zener diode
   a. Used in voltage regulation
   b. Connected for reverse bias
   c. Will maintain the breakdown voltage across it

Show Transparency fig. 10

2. Tunnel diode
   a. Used in high frequency (RF) applications
   b. Exhibits negative resistance characteristic
3. Light emitting diode
   a. Emits light when forward biased
   b. Light given off as carriers combine at the junction
   c. Typical forward bias is 1.5 to 2 Volts
   d. LED numeric display made up of several LED's

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Diodes
2. Experiment #40 - Semiconductor Diodes
3. Experiment #44 - Zener Diodes
4. Check each student's work for accuracy and completeness
5. Task Sheet - Diode Checking
6. Answer any student question

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIAL PRESENTED.)

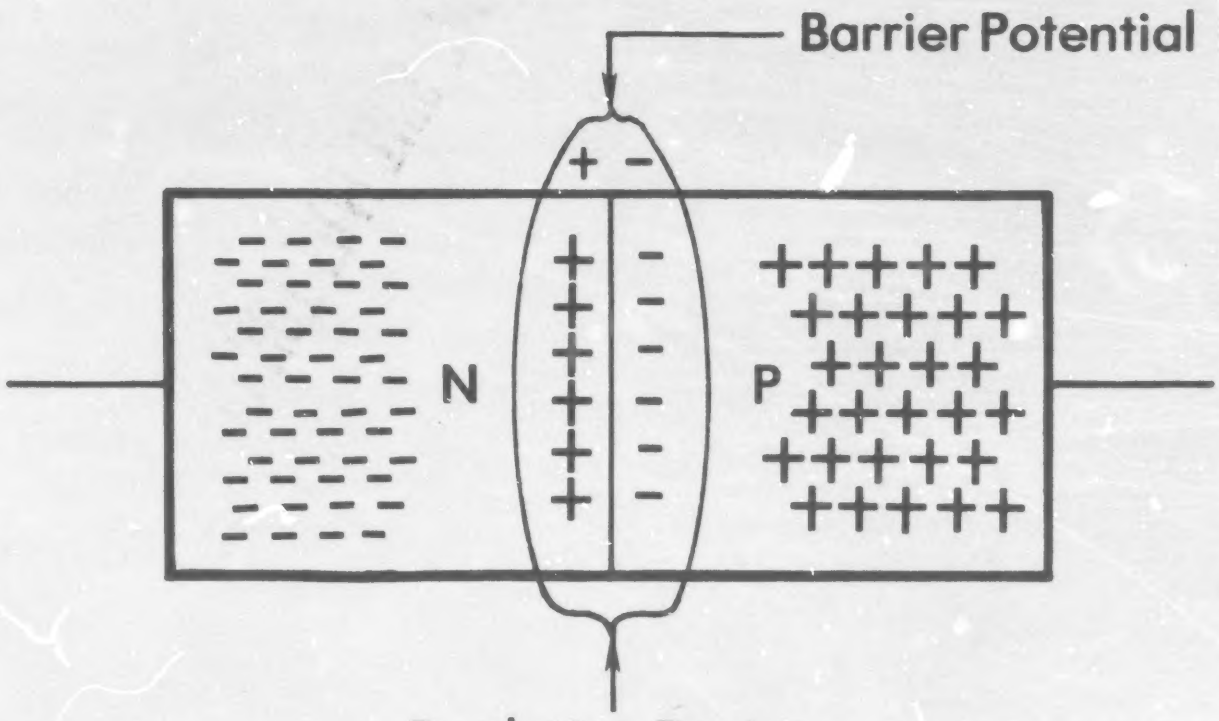
1. Ask oral questions
2. Test Sheet - Diodes
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss the test and answer student questions
2. Review the major topics of the lesson presentation

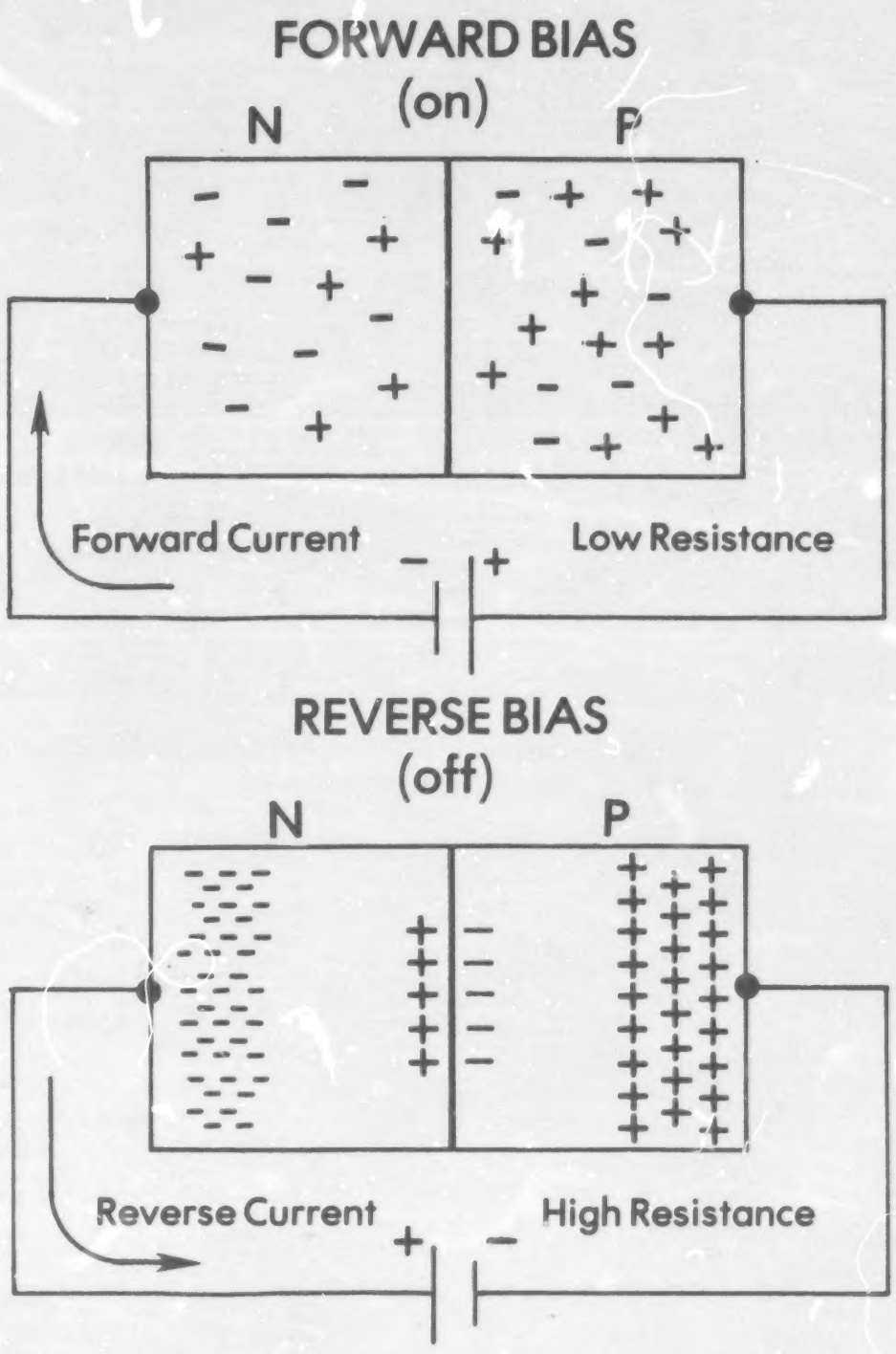
THE NEXT LESSON IS: Transistors

P - N JUNCTION DIODE



Depletion Region
forms
Barrier Potential
0.6 to 0.7 Volt-Silicon
0.2 to 0.3 Volt-Germanium

PN JUNCTION BIAS

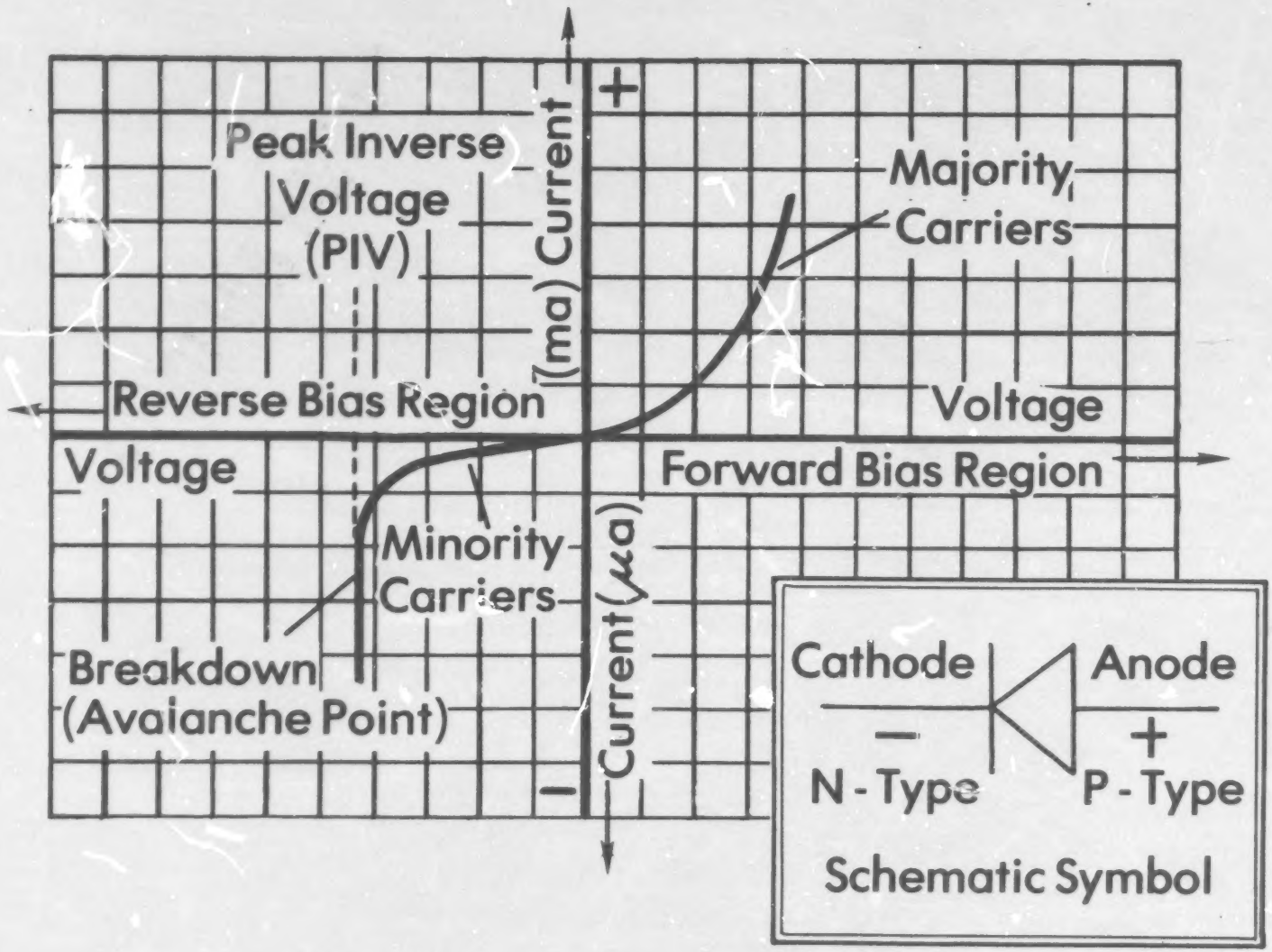


Increase in reverse bias widens depletion region and increases barrier potential

19501

fig. 7

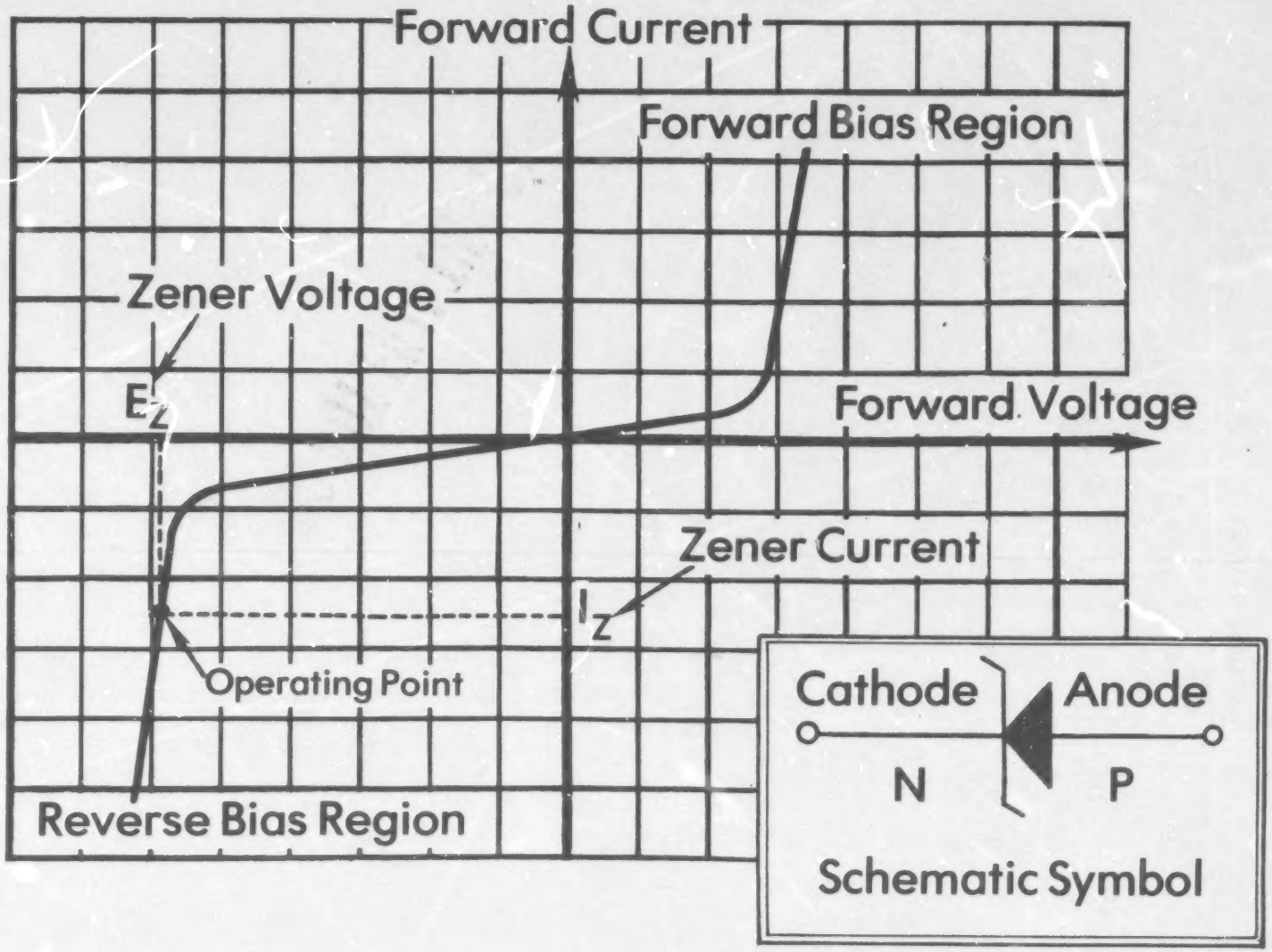
VOLTAGE - CURRENT CHARACTERISTIC CURVE



19501

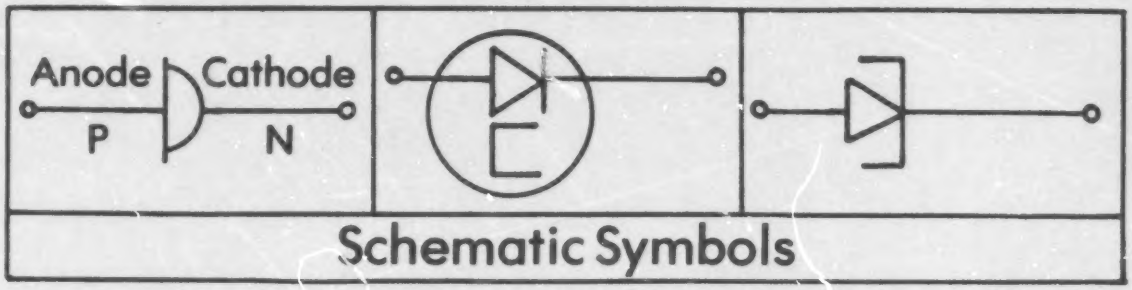
fig. 8

ZENER DIODE

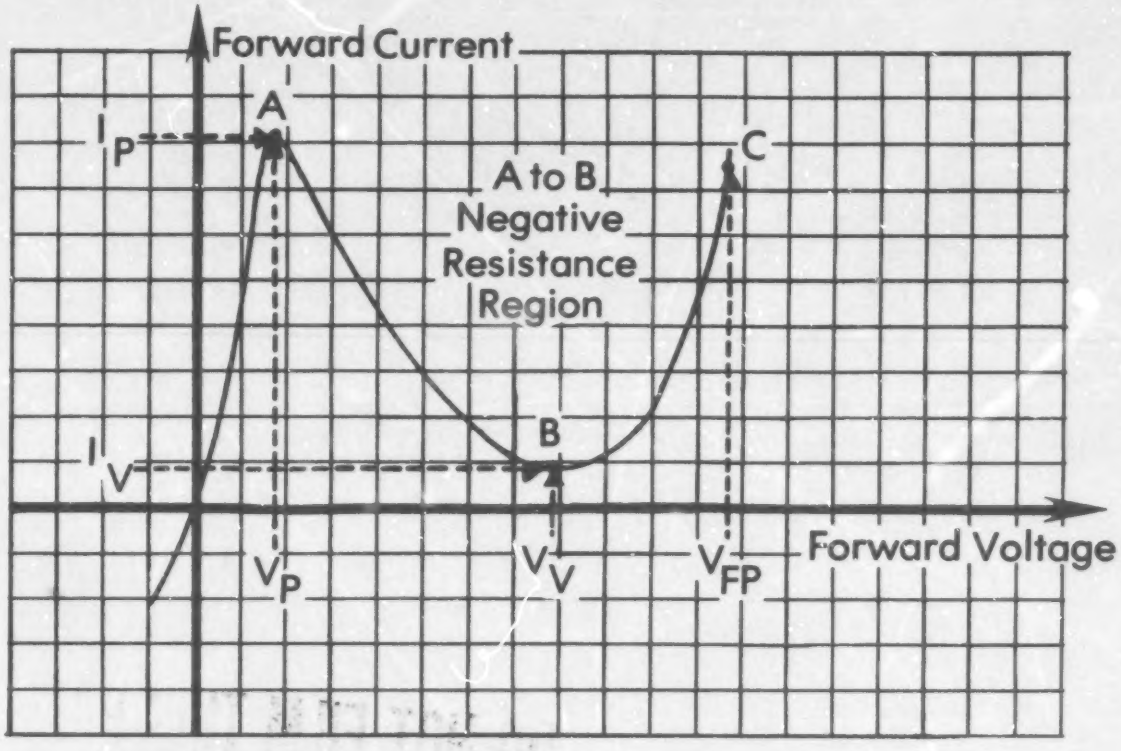


73

TUNNEL DIODE



Schematic Symbols



A { I_P → Peak-Point Current; V_P → Peak-Point Voltage }

B { I_V → Valley-Point Current; V_V → Valley-Point Voltage }

C { V_{FP} → Forward -Point Voltage }

DIODES IX-B-1(AS)
Key

Name _____ Date _____

Directions: Read each statement carefully and place the correct answer in the space provided. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

Diode 1. A _____ is formed when a semiconductor crystal contains sections of N-Type and P-Type materials.

Depletion 2. As a PN junction is formed, a _____ region is created.

Barrier 3. The ____ voltage is created when the PN junction is formed.

Cathode 4. To forward bias a diode, the ____ lead is connected to the negative terminal of the voltage source.

Anode 5. To reverse bias a diode, the ____ lead is connected to the negative terminal of the voltage source.

Low 6. A forward biased diode has very _____ resistance.

High 7. A reversed biased diode has very _____ resistance.

Majority 8. The _____ carriers of the P and N materials sustain current flow in a forward biased diode.

Barrier voltage 9. The forward bias voltage must be greater than the ____ to turn on the diode.

Leakage 10. When a diode is reversed biased, a small _____ current will flow.

0.6 to 0.7 11. A forward biased silicon diode will have a voltage drop of about _____ Volts across it.

0.2 to 0.3 12. A forward biased germanium diode will have a voltage drop of about _____ Volts across it.

Negative 13. Semiconductor diodes have a ____ temperature coefficient.

Peak inverse voltage 14. The maximum reverse bias voltage a diode can withstand without being destroyed is called the _____.

Bar 15. The N section of a diode is represented by the _____ in the diode symbol.

Triangle 16. The P section of a diode is represented by the _____ in the diode symbol.

Forward 17. A diode is ____ biased when the cathode is connected to the negative side of the source voltage.

False 18. A junction diode is formed by pressing P and N type material together. (True/False)

Band 19. A _____ may be used to mark the cathode end of a diode.

Stud mount 20. Diodes which must handle large forward currents are placed in a metal _____ package to help dissipate heat.

Rectifier 21. A/an _____ diode is used in the process of converting AC to DC.

Zener 22. A/an _____ diode is designed to operate in the breakdown region.

Reverse 23. Zener diodes are usually used in applications where they are _____ biased.

Regulation 24. Zener diodes are used in circuits for ____ voltage.

Tunnel 25. A/an ____ diode exhibits a negative resistance region in its characteristic curve.

High 26. Tunnel diodes are used at _____ frequencies.

Light emitting diode 27. The abbreviation LED stands for _____.

Recombine 28. An LED gives off light when the current carriers _____ at the junction.

Forward 29. An LED must be _____ biased at about 1.5 to 2.0 Volts to be operated.

Display 30. Several LED's can be combined to make an alpha-numeric ____.

Name _____ Date _____

Objective: Upon successful completion, the student will be able to demonstrate a practical method to test diodes and identify their leads using a VOM.

Reference: Schuler, Electronics-Principles and Applications

Directions: Read the textbook reference. Make the measurements called for in the procedure. Record the results in the spaces provided for each diode. Be sure to check your measurements.

Procedure:
1. Measure the forward resistance of the diode using your VOM.
2. Measure the reverse resistance of the diode using your VOM.
3. Compare the two readings to determine if there is a high ratio between the measurements.
4. A high ratio indicates a good diode.
5. A low ratio indicated a defective diode.

Data:

	Forward Resistance	Reverse Resistance	Good or Bad
Diode #1			
Diode #2			
Diode #3			
Diode #4			
Diode #5			
Diode #6			
Diode #7			
Diode #8			
Diode #9			
Diode #10			

TEST

IX-B-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Place the word or words which best completes the statement in the space provided. Be sure to use correct spelling and check your answers.

Barrier 1. The ___ voltage is created when the PN junction is formed.

Majority 2. The ___ carriers of the P and N materials sustain current flow in a forward biased diode.

Depletion 3. As a PN junction is formed, a ____ region is created.

False 4. A forward biased silicon diode will have a voltage drop of about 0.2 Volts across it. (True/False)

Low 5. A forward biased diode has very ___ resistance.

True 6. The cathode lead of a diode is connected to the negative terminal of the source to forward bias the diode. (True/False)

Barrier voltage 7. The forward bias voltage must be greater than the ___ to turn on the diode.

Negative 8. Semiconductor diodes have a ___ temperature coefficient.

Triangle 9. The P section of a diode is represented by the ___ in the diode symbol.

True 10. A Zener diode is designed to operate in the breakdown region. (True/False)

Tunnel 11. A/an ___ diode exhibits a negative resistance region in its characteristic curve.

PIV 12. The maximum reverse bias voltage a diode can withstand without being destroyed is called the _____.

Mark 13. A ___ is placed on the cathode end of a diode.

True 14. Metal cases are used on diodes to help prevent heat damage. (True/False)

Recombine 15. An LED gives off light when the current carriers ___ at the junction.

INSTRUCTOR'S PLAN IX-C-1(I)
INFORMATIONAL LESSON

SUBJECT:	Transistors
AIM:	Upon successful completion of the lesson, the student will be able to: correctly identify transistor schematic symbols, describe the construction and operation of bipolar transistors, identify common transistor case styles, and test bipolar transistors for type and internal defects using an ohmmeter.
TEACHING AIDS:	Chalkboard, overhead projector, Transparency Set 19501 figs. 11-14
MATERIALS:	Assignment Sheet - Transistors Task Sheet - Transistor Testing Lab Experiment #47 - The Transistor Test Sheet - Transistors
TOOLS AND EQUIPMENT:	Student lab station Miscellaneous transistors
REFERENCE:	Schuler, Electronics-Principles and Applications
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

In this lesson, you will become familiar with the transistor which is one of the basic semiconductor components. The transistor is very common and widely used. Every area of electronics uses the transistor. This requires all persons working in the field to have a solid understanding of them. An understanding of the bipolar junction transistor will help you to understand the more complex components later. We will cover the characteristics, applications, construction, and testing.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Bipolar Transistor Show Transparency fig. 11	1. Bipolar-botn electrons and holes used for current flow 2. Materials a. Silicon b. Germanium
Show Transparency fig. 12	3. Types a. PNP b. NPN 4. Regions a. Emitter - heavily doped, emits the current carriers b. Base - very lightly doped, controls the flow of current c. Collector - very lightly doped, collects the current carriers

Show Transparency fig. 13

5. Junctions
   a. Base-emitter junction must be forward biased for normal operation
   b. Collector-base junction must be reversed biased for normal operation

B. Characteristic Curves

1. Collector family of curves
   a. Comparison of collector to emitter voltage affect on collector current
   b. Used to predict operation characteristics for a specific transistor
2. Constant-power curve
   a. Comparison of collector to emitter voltage affect on collector current
   b. Used to predict transistors power dissipation

C. Packaging

1. TO 3
   a. Metal case
   b. Power transistor
2. TO 5
   a. Metal case
   b. Medium power and small signal
3. TO 92
   a. Plastic
   b. Lower power and small signal
4. TO 220
   a. Metal and plastic
   b. Power and other applications

D. Testing

1. Check emitter-base junction
   a. Connect ohmmeter leads
   b. Measure resistance
   c. Reverse leads
   d. Compare measured values
   e. Low ratio indicates bad junction
   f. High ratio indicates good junction
2. Check collector-base junction
   a. Connect ohmmeter leads
   b. Measure resistance
   c. Reverse leads
   d. Compare measured values
   e. Low ratio indicates bad junction
   f. High ratio indicates good junction

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Transistors
2. Experiment #47 - The Transistor
3. Task Sheet - Transistor Testing

4. Check each student's work for accuracy and completeness
5. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

1. Ask oral questions
2. Test Sheet - Transistors
3. 70% correct is required for satisfactory completion of the lesson

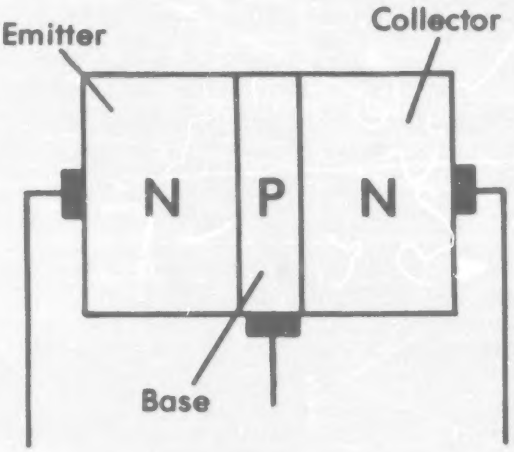
V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss the test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Special Semiconductors

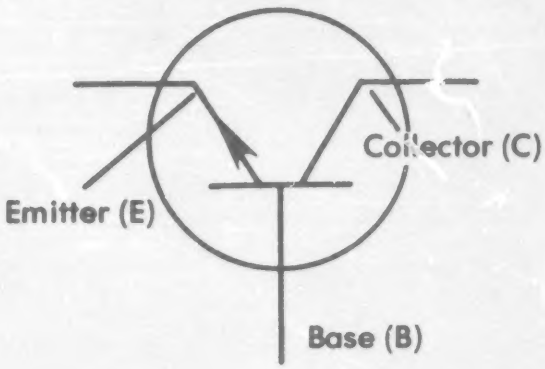
TRANSISTORS

BLOCK DIAGRAMS

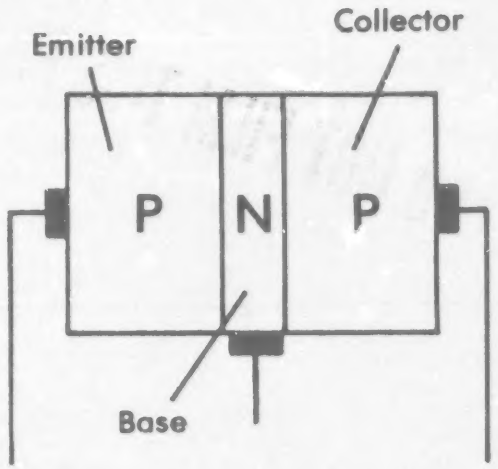


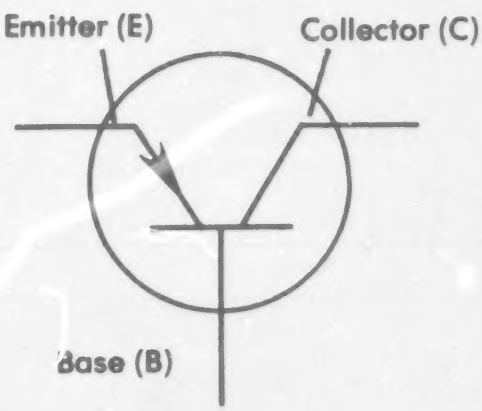
SCHEMATIC DIAGRAMS

Note the arrow on the emitter lead points to N-Type material on both.



NPN Transistor

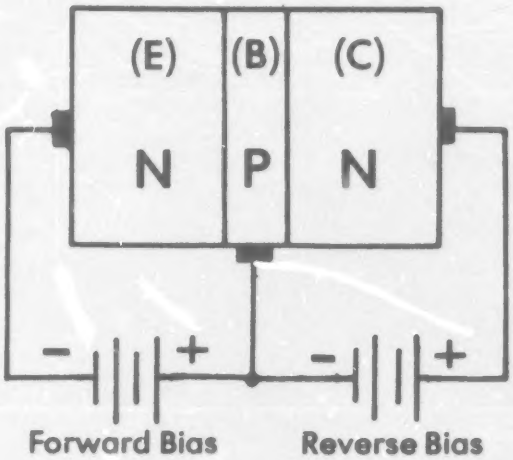




PNP Transistor

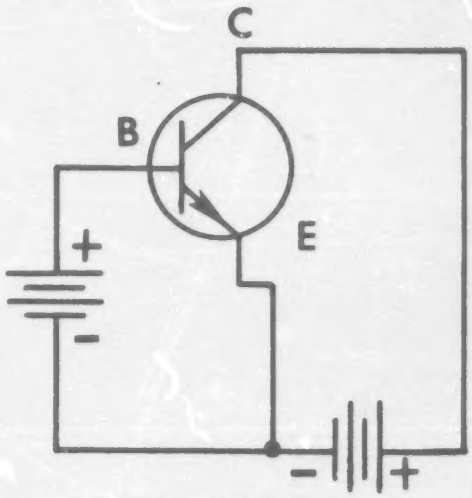
BIASED TRANSISTORS

Common Base



BLOCK

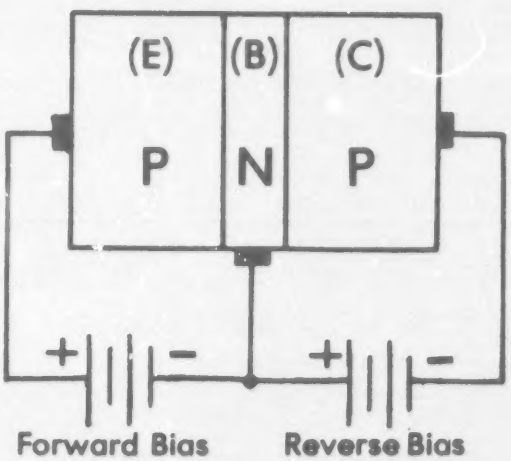
Common Emitter



SCHEMATIC

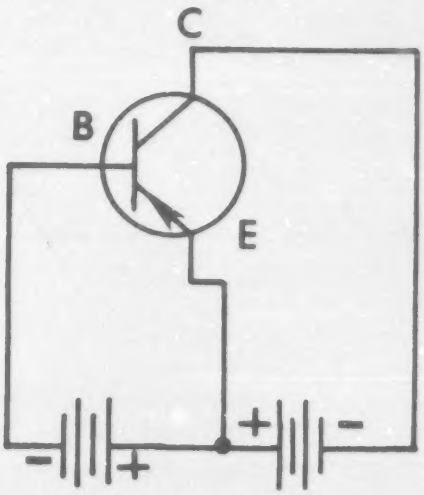
NPN Transistor Bias

Common Base



BLOCK

Common Emitter



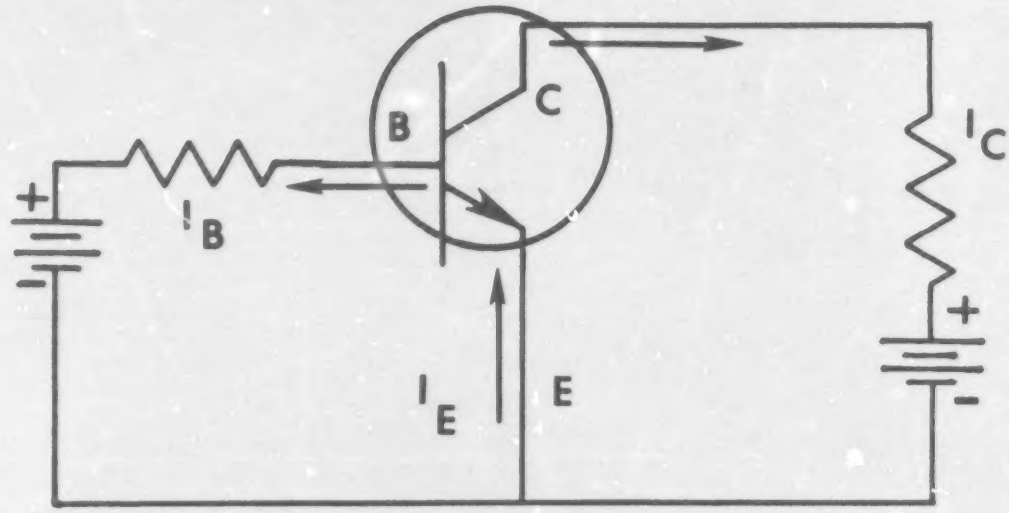
SCHEMATIC

PNP Transistor Bias

19501

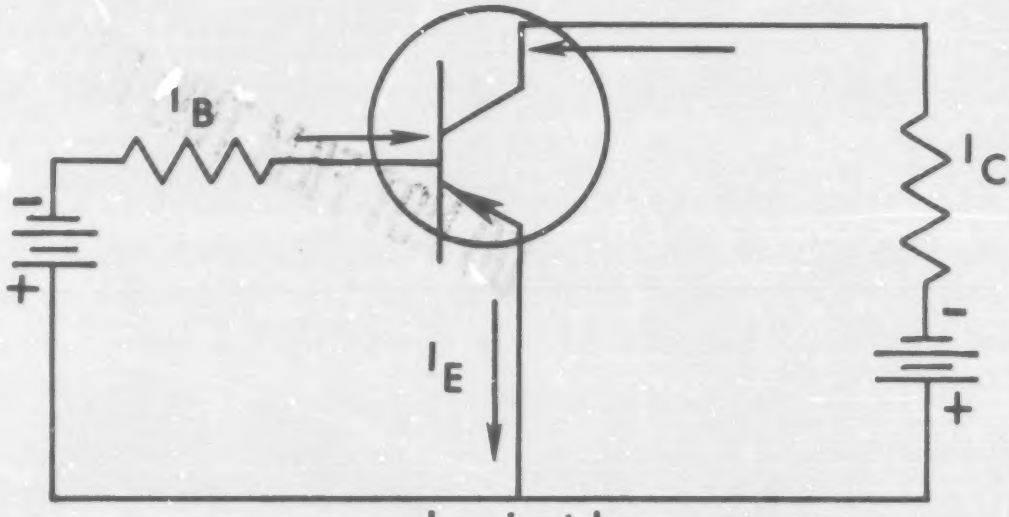
fig. 12

TRANSISTOR ELECTRON FLOW



$I_E = I_B + I_C$

NPN Circuit



$I_E = I_B + I_C$

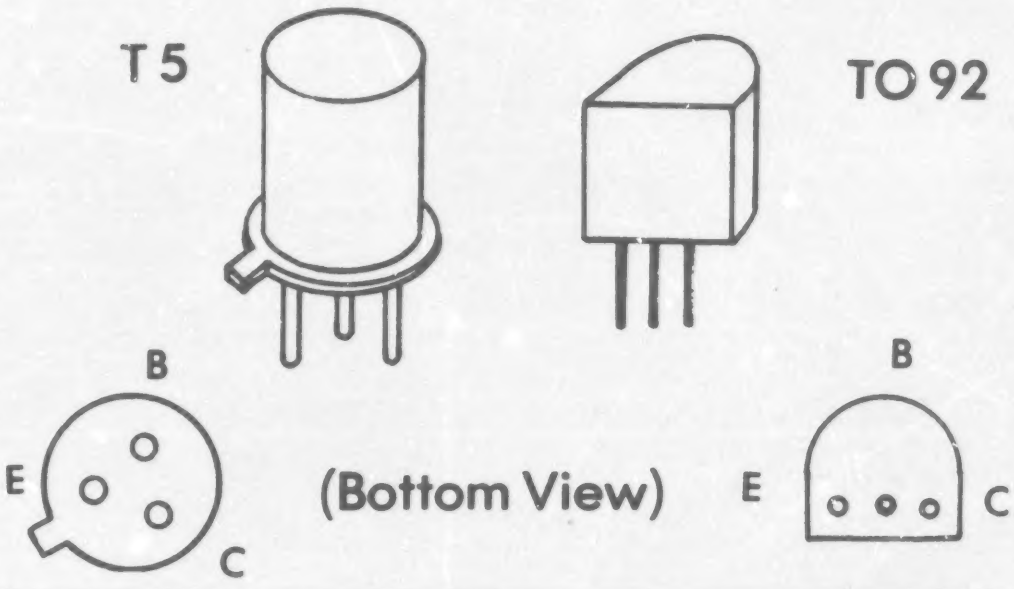
PNP Circuit

19501

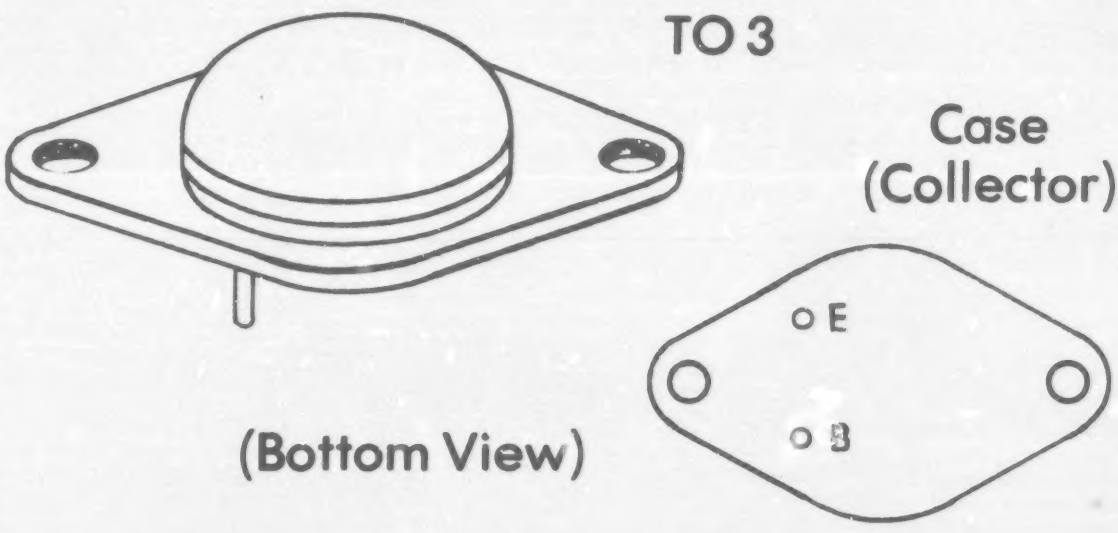
fig. 13

TRANSISTOR TYPES

Small Signal Transistors



Power Transistor



NOTE: THERE MAY BE OTHER BASE DIAGRAMS

19501

fig. 14

TRANSISTORS IX-C-1(AS)
Key

Name _____ Date _____

Directions: Read each statement carefully and place the correct answer in the space provided. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

Transistor 1. A/an ____ is formed when a semiconductor crystal contains two sections of one type of material separated by a section of the other.

Bipolar 2. Electrons and holes are both used as current carriers in ____ junction transistors.

Emitter 3. The ____ region of a transistor is heavily doped.

Base 4. The ____ region of a transistor is thin and very lightly doped.

Two 5. A bipolar junction transistor contains ____ junctions.

Emitter 6. The arrow in the transistor symbol indicates the ____ lead.

Reverse 7. The collector-base junction must be ____ biased for proper operation.

Forward 8. The emitter-base junction must be ____ biased for proper operation.

Germanium 9. Silicon and ____ are used in the construction of bipolar transistors.

Silicon 10. The most popular semiconductor material for transistor construction is _____.

Holes 11. The emitter of a PNP transistor emits ____ as the current carrier.

NPN 12. The collector of a/an _____ transistor collects electrons.

PNP 13. The emitter lead arrow in the schematic diagram symbol points in for a _____.

NPN 14. The emitter lead arrow in the schematic diagram symbol points out for a _____.

15. Draw the schematic diagram symbol for a PNP transistor.

16. Draw the schematic diagram symbol for an NPN transistor.

Directions: Read each statement carefully. Indicate if the statement is True or False by placing a T or F in the space provided. Be sure to check your answers.

F 17. A transistor in a TO-3 case would be used in a small signal amplifier.

T 18. Bipolar transistors made from silicon can withstand more heat.

F 19. Transistors made from germanium are never used.

T 20. Transistor junctions can be checked with an ohmmeter.

F 21. All transistors have the leads identified on the case.

T 22. Each junction of a transistor can be checked with the same procedure as a diode.

T 23. Data sheets are available for all semiconductor devices.

T 24. The positive and negative leads must be identified for checking transistors on an ohmmeter.

F 25. Some bipolar transistors do not use holes as current carriers.

Name _____ Date _____

Objective: Upon successful completion, the student will be able to demonstrate a practical method of testing transistors using a VOM.

Reference: Schuler, Electronics-Principles and Applications

Directions: Read the textbook reference. Make the measurements called for in the procedure. Record the results in the spaces provided for each diode. Be sure to check your measurements.

Procedure:
1. Measure the forward resistance of the emitter-base junction using your VOM.
2. Measure the reverse resistance of the emitter-base junction using your VOM.
3. Compare the two readings to determine if there is a high ratio between the measurements.
4. Repeat steps 1, 2, and 3 for the collector-base junction using your VOM.
5. A high ratio indicates a good junction.
6. A low ratio indicates a defective junction.

Data:		Forward Resistance	Reverse Resistance	Good or Bad
Q 1	Emitter-Base			
	Collector-Base			
Q 2	Emitter-Base			
	Collector-Base			
Q 3	Emitter-Base			
	Collector-Base			
Q 4	Emitter-Base			
	Collector-Base			
Q 5	Emitter-Base			
	Collector-Base			

TEST IX-C-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Place the word or words which best completes the statement in the space provided. Be sure to check your answers.

Bipolar
1. Electrons and holes are used as current carriers in ___ junction transistors.

True
2. Transistor junctions can be checked with an ohmmeter. (True/False)

Base
3. The ___ region of a transistor is thin and very lightly doped.

False
4. Some bipolar transistors do not use holes as current carriers. (True/False)

Two
5. A bipolar junction transistor contains ____ junctions.

Collector-base
6. The ___ junction must be reverse biased for proper operation.

True
7. Each junction of a transistor can be checked with the same procedure as a diode. (True/False)

Forward
8. The emitter-base junction must be ___ biased for proper operation.

False
9. All transistors have the leads identified on the case. (True/False)

Holes
10. The emitter of a PNP transistor emits ___ as the current carrier.

Collector
11. The ___ section of a bipolar transistor collects the current carriers.

PNP
12. The emitter lead arrow in the schematic diagram symbol points in for a ___.

True
13. Bipolar transistors made from silicon can withstand more heat than transistors made of germanium. (True/False)

Transistor outline
14. Transistor case types are identified using TO. TO stands for ___.

15. Draw the schematic symbol for an NPN transistor.

INSTRUCTOR'S PLAN
INFORMATIONAL LESSON

IX-D-1(I)

SUBJECT:	Special Semiconductors
AIM:	Upon successful completion of the lesson, the student will be able to describe the construction and operation of field effect transistors, silicon controlled rectifiers and integrated circuits.
TEACHING AIDS:	Chalkboard
MATERIALS:	Assignment Sheet - Special Semiconductors Lab Experiment #46 - The Silicon Controlled Rectifier Lab Experiment #49 - The Field Effect Transistor Test Sheet - Special Semiconductors
TOOLS AND EQUIPMENT:	Student lab station
REFERENCE:	Schuler, Electronics-Principles and Applications
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

In this lesson you will learn about the construction and operation of some special purpose semiconductor devices. These devices are constructed to do a specific job. Their use is very common and you as an electronics technician or engineer must be familiar with each.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Field Effect Transistors	1. JFET - Junction Field Effect Transistors a. Unipolar devices - uses only one type of current carrier b. N-channel - only electrons are used as current carriers c. P-channel - only holes are used as current carriers d. Schematic symbols 1.) N-channel JFET 2.) P-challen JFET e. JFET operate in the depletion mode f. Unipolar devices are voltage controlled 2. MOSFET - Metal Oxide Semiconductor Field Effect Transistor a. MOSFET operate in the enhancement mode

b. Schematic symbol
   1.) N channel
   2.) P channel
c. Use handling precautions - some are static sensitive
d. Voltage controlled devices

B. SCR - Silicon Controlled Rectifier

1. Used as switch for circuit control
2. Four layer device alternating P and N type material
3. Schematic symbol
4. Sections
   a. Anode - collectors current carriers
   b. Cathode - emits current carriers
   c. Gate - control element

C. IC - Integrated Circuits

1. Many components in a single package design to be a complete circuit
2. Reduce the total number of components to be mounted on circuit boards or in circuits
3. Discrete circuit made up of individual components, require more space than IC's
4. Used for both digital and analog circuits
5. MOS/LSI - Metalic Oxide Semiconductor/ Large Scale Integration
6. Packaging
   a. DIP - Dual Inline Pin Package - most popular containing 8, 14, 16, and more pins
   b. TO-220 - 3 lead transistor package
   c. TO-3 - power transistor package
   d. TO-5 - round package with 8, 10, or 12 leads
7. Construction types
   a. Monolithic integrated circuit - all components are made using a single chip of silicon
   b. Hybrid integrated circuit - various types of components mounted on a common substrate
8. Advantages
   a. Many components mounted in small space
   b. Low cost of circuits
   c. Low power consumption
9. Disadvantages
   a. Must replace entire circuit for a single component failure
   b. Highly specialized, designed for a specific application

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Special Semiconductors
2. Experiment #46 - The Silicon Controlled Rectifier
3. Experiment #49 - The Field Effect Transistor
4. Check each student's work for accuracy and completeness
5. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

1. Ask oral questions
2. Test Sheet - Special Semiconductors
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss the test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Power Supplies

SPECIAL SEMICONDUCTORS IX-D-1(AS)
Key

Name _____ Date _____

Directions: Define each of the following terms in the space provided. You may use your textbook and class notes as reference. Be sure to use correct spelling and grammar. If you have any questions, ask your instructor.

1. Unipolar Transistor: _____

A transistor which used only one type of current carrier, either electrons or holes.

2. JFET: _____

A junction field effect transistor is a unipolar device which is voltage controlled.

3. Depletion Mode: _____

A voltage applied to the gate will deplete the carriers in the channel.

4. MOSFET: _____

Metal oxide semiconductor field effect transistor using an oxide as an insulating material.

5. Enhancement Mode: _____

A voltage applied to the gate will attract carriers to the region.

6. UJT: _____

A unijunction transistor operates in an enhancement mode and exhibits a negative resistance.

7. Negative Resistance: _____

The characteristic of a UJT that results in a decreasing voltage drop which increases current.

8. **Discrete Circuit:** Circuits constructed for specific functions using individual components

9. **DIP Package:** Dual inline pin package having connection pins arranged in rows and used for integrated circuits.

10. **Substrate:** The ceramic or silicon base on which an integrated circuit is built.

11. **Monolithic IC:** An integrated circuit constructed from a single crystal of silicon.

12. **Hybrid IC:** An integrated circuit constructed on a ceramic substrate using various types of components.

13. **SCR:** A silicon controlled rectifier used to control current in an electronic circuit.

14. **Latch Circuit:** A circuit in which a voltage is applied to cause a switching action. It remains until another voltage is applied.

15. **Gate:** Control section of a silicon controlled rectifier.

TEST

IX-D-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Place the word or words which best completes the statement in the space provided. Be sure to check your answers.

Dual Inline Pin

1. A very common IC package is the DIP package. DIP stands for _____.

True

2. There are three junctions in an SCR. (True/False)

Current

3. A silicon controlled rectifier is a _____ controlled device.

False

4. Field effect transistors are current controlled devices. (True/False)

FET

5. A/an ____ has three leads: source, gate, and drain.

Off

6. When the forward current in an SCR drops to zero, the device is turned _____.

False

7. Integrated circuits usually contain diodes, transistors, resistors and inductors. (True/False)

Negative Resistance

8. An unijunction transistor exhibits a unique characteristic called _____.

True

9. Discrete components are individually connected in the circuit. (True/False)

Substrate

10. The ____ is the ceramic or silicon material which is used to construct semiconductor components on.

INSTRUCTOR'S PLAN X-A-1(I)
INFORMATIONAL LESSON

SUBJECT:	Power Supply Circuits
AIM:	Upon successful completion of the lesson, the student will be able to draw, name parts, construct, analyze and troubleshoot various power supply circuits.
TEACHING AIDS:	Chalkboard, overhead projector, Transparency Set 19501, figs. 15-19
MATERIALS:	Assignment Sheet - Power Supply Circuits Lab Experiment #41 - Rectifiers, Half-Wave and Full-Wave Lab Experiment #42 - Filters and Voltage Doublers Test Sheet - Power Supply Circuits
TOOLS AND EQUIPMENT:	Student lab station
REFERENCES:	Schuler, Electronics-Principles and Applications
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

In this lesson you will become familiar with the various power supply circuits. Most electronic equipment requires the conversion of alternating current to the direct current needed to operate the circuits. This conversion is provided by the power supply. You will also become involved with analyzing the circuits for proper operation. This will help you in the troubleshooting process and in the circuit repair.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Systems	1. Power supplies convert available electrical source into a form required by various sections of the equipment
Show Transparency fig. 15	2. Block diagram
B. Power Source	1. Alternating current sources most common 2. Typical voltages of 120 and 220 are supplied 3. Most circuits require lower voltages 4. Transformers are used to step down the voltage 5. Source section of power supply usually includes: a. AC power plug and cord b. Fuse c. Switch d. Pilot lamp e. Transformer

C. Rectification

1. Section is used to convert alternating current into direct current
2. Diodes are used for this conversion
3. The negative side of the load will always connect to the anode end of the rectifier diodes

Show Transparency fig. 16

4. Half-wave rectifier
   a. Rectifier circuit uses only one diode
   b. Does not require transformer
   c. Only half of the input wave is allowed in the output
   d. Used for high current applications
   e. Low cost due to requiring only one diode
5. Full-wave rectifier
   a. Rectifier requires two diodes
   b. Requires center-tapped transformer
   c. Both half cycles appear in the output
   d. Easier to smooth out as direct current
   e. Requires expensive transformer

Show Transparency fig. 17

6. Bridge rectifier
   a. Rectifier used four diodes
   b. Does not require transformer source
   c. Both half cycles of input appear in the output
   d. Easier to smooth out of filter than half wave
   e. Low cost for full wave rectification (4 diodes)

D. Filtering

Show Transparency fig. 18

1. Output of rectifier is pulsating DC and not pure
2. Ripple is the AC component of the DC output of a rectifier
3. Filtering circuit is used to remove the ripple from the rectified DC
4. Filter capacitors try to maintain a constant voltage
5. Capacitor input filter
   a. Simple capacitor across rectifier output
   b. Decreases ripple in output
6. Choke input filter
   a. Choke coil in series with output of rectifier
   b. Works in combination with capacitor
   c. Better filtering than using only capacitor
   d. Higher cost due to choke coils
7. Pi filter
   a. Excellent filtering
   b. Uses two capacitors and choke coil

c. Less output voltage but is more stable
d. Resistors are sometimes used instead of choke coils

E. Regulation

1. Keeping the output voltage stable with changes in load current
2. Zener regulator
   a. Zener diode placed in parallel with load
   b. Uses resistor in series with load current
   c. Must be designed around specific load current
3. IC regulator
   a. Integrated circuit designed to maintain a specific voltage across its output
   b. Most have specified voltage output value
   c. Have maximum current value
   d. Advantage is load current can vary

F. Troubleshooting

1. The process of determining malfunction in circuit

Show Transparency fig. 19

2. Troubleshooting steps (Text reference pg. 47)
   a. Observe symptoms
   b. Analyze possible causes
   c. Limit possibilities
3. Replace defective components with equal values

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Power Supply Circuits
2. Experiment #41 - Rectifiers, Half-Wave and Full-Wave
3. Experiment #42 - Filters and Voltage Doublers
4. Check each student's work for accuracy and completeness
5. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

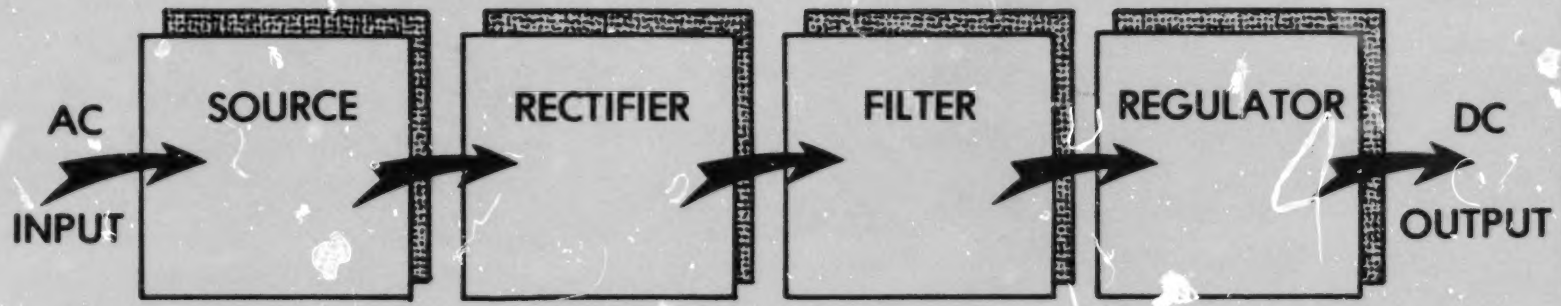
1. Ask oral questions
2. Test Sheet - Power Supply Circuits
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss the test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Amplifier Circuits

POWER SUPPLY BLOCK DIAGRAM

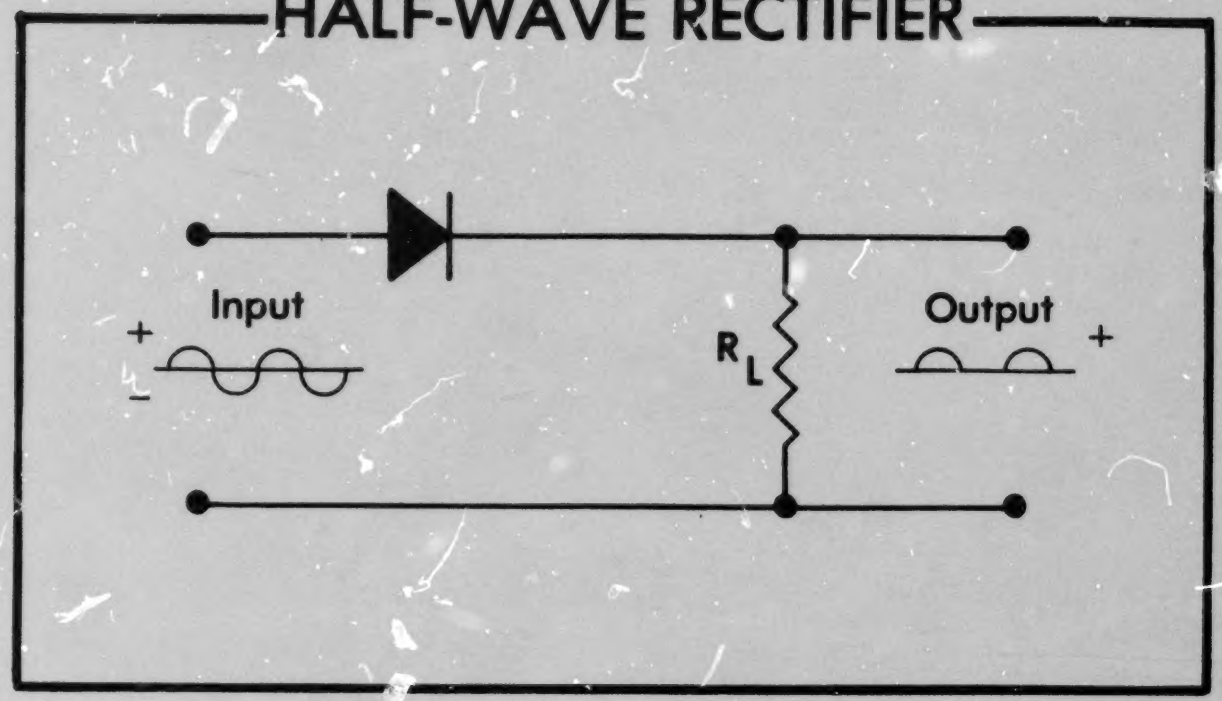


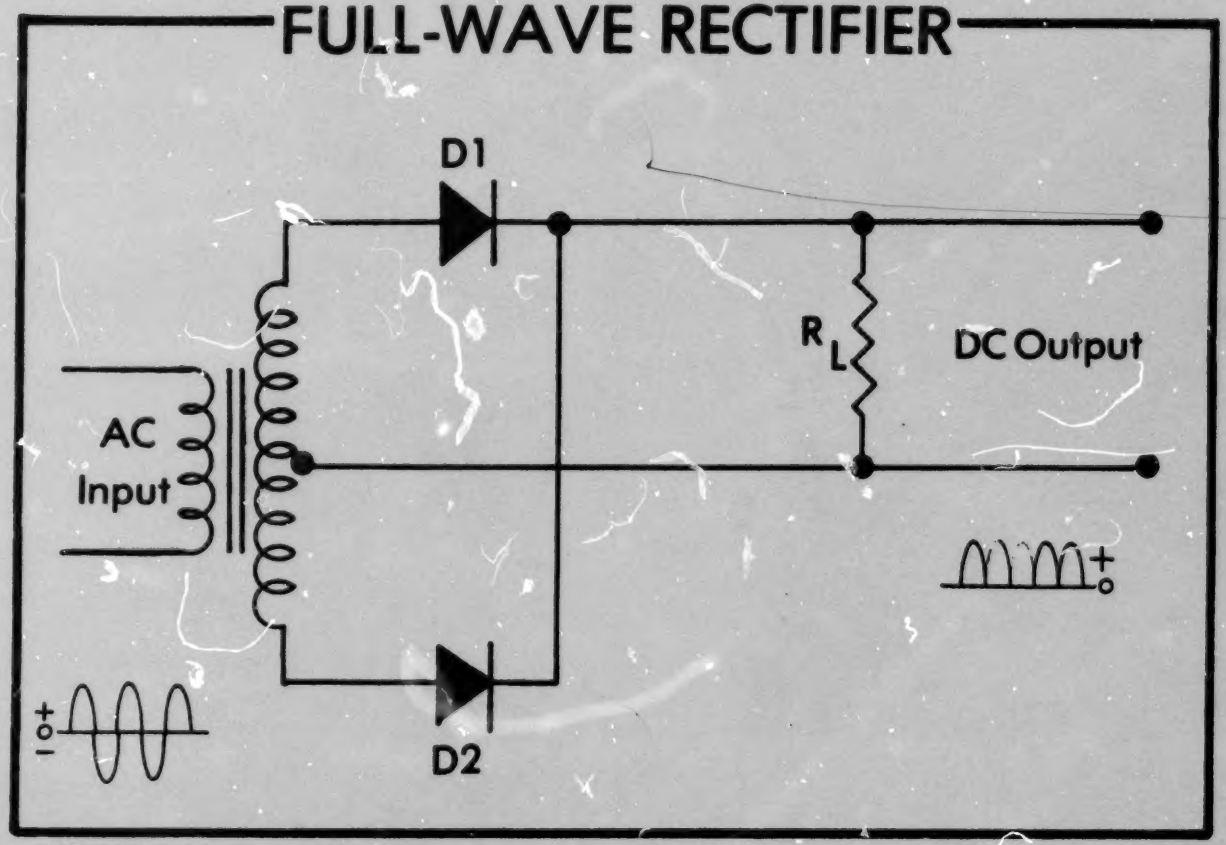
101

102

19501

fig. 15

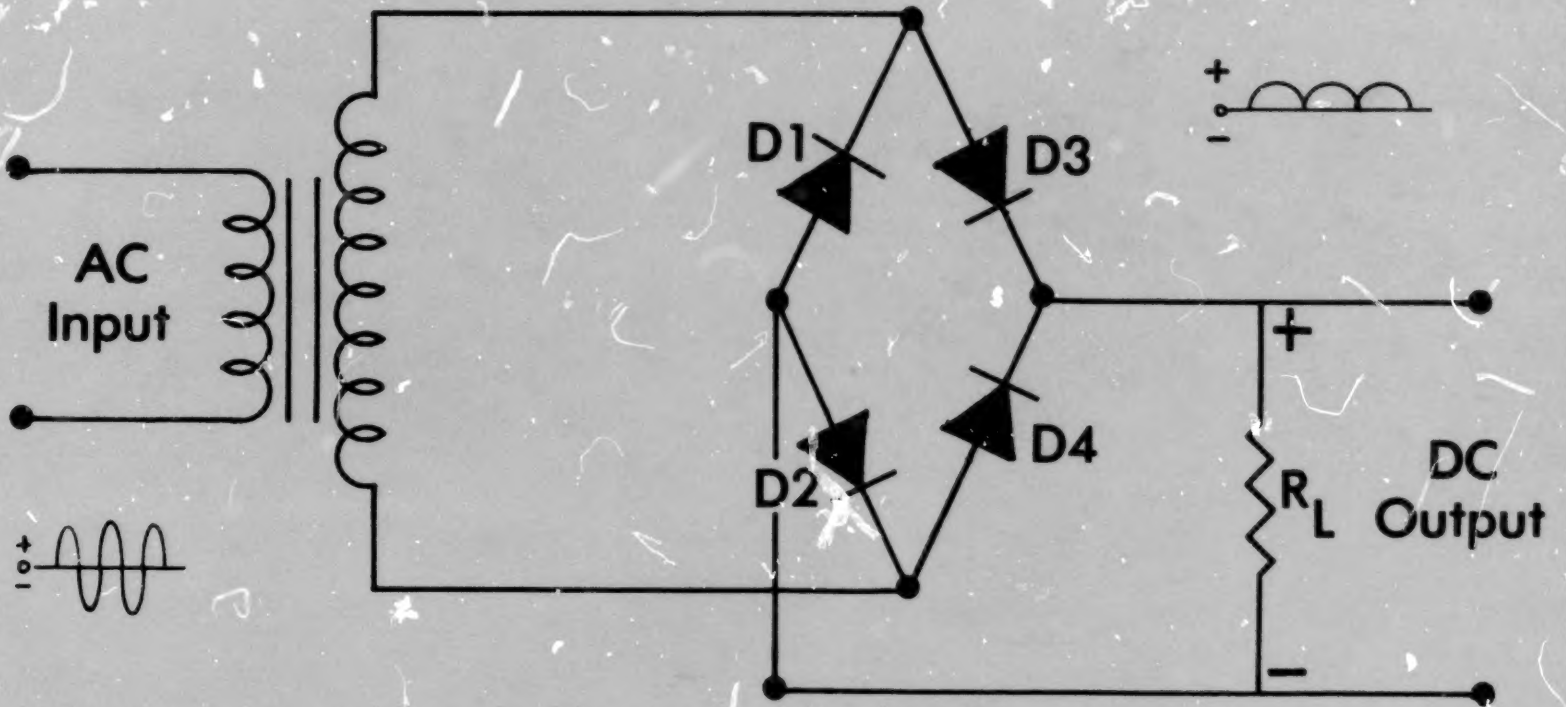

HALF-WAVE RECTIFIER
Input
+
–
R_L
Output
+


FULL-WAVE RECTIFIER
D1
AC
Input
R_L
DC Output
+
–
D2

19501

fig. 16

BRIDGE RECTIFIER

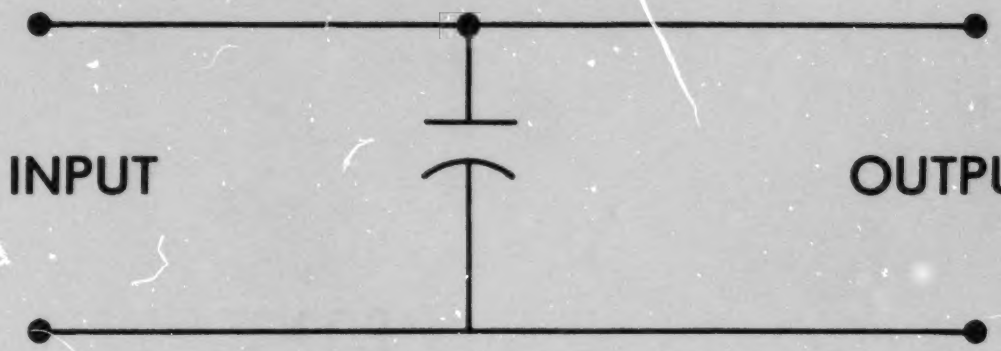


19501

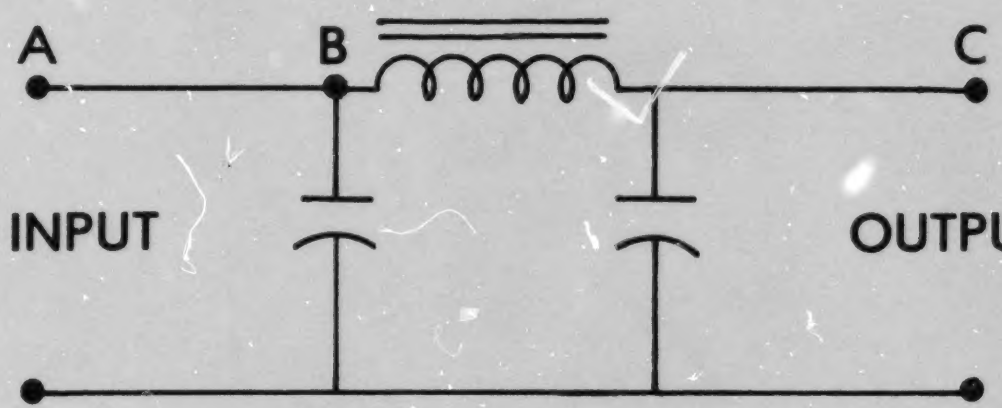
fig. 17

BASIC FILTER CONFIGURATIONS

Capacitor Filter



PI-Section Filter



STEPS FOR GOOD TROUBLESHOOTING

1. Observe Symptoms

2. Analyze Symptoms

3. Limit Possibilities

POWER SUPPLY CIRCUITS X-A-1(AS)
Key

Name _____ Date _____

Directions: Read each statement carefully and place the correct answer in the space provided. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

Rectifier 1. A/an ____ circuit is used to convert alternating current into direct current.

Transformer 2. For safety, a/an ____ is used to provide isolation between the electronic circuit and the AC power line.

Half-Wave 3. A/an ____ rectifier circuit requires only one diode.

120 Hz 4. A full-wave rectifier has a ripple frequency of ____.

Bridge 5. A/an _____ rectifier requires four diodes and has a full-wave output.

Capacitor 6. A filter can be constructed by using only a _____.

Increase 7. Adding a filter circuit to a power supply will cause the output voltage to _____.

Regulator 8. To keep the output voltage of a power supply constant with changing load currents, a/an ____ circuit should be used.

Zener 9. A/an ____ diode can be used to help regulate a power supply.

Fuse 10. The source section of a power supply should contain a switch and a ____ for safety.

Observe 11. The first step in trouble shooting a power supply is to ____ the operation.

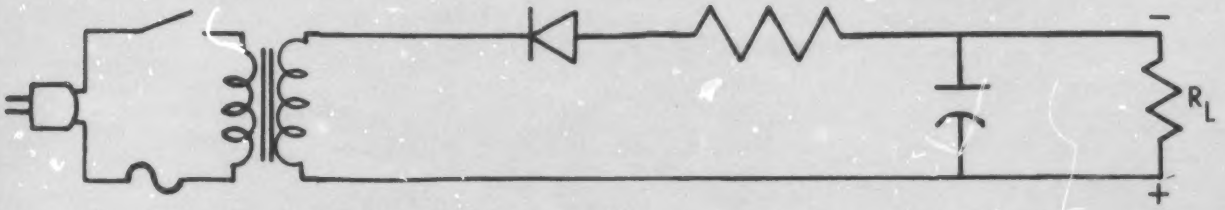
Diode 12. To reverse the output voltage of a half-wave rectifier, the _____ must be reversed.

False 13. Full-wave rectifiers are harder to filter than half-wave. (True/False)

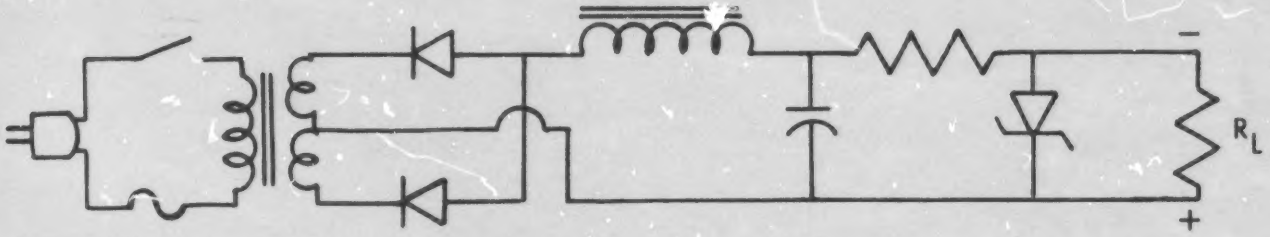
Load 14. The output voltage of a power supply can be affected by the ___ current.

True 15. A burned resistor may indicate another defective component in a power supply circuit. (True/False)

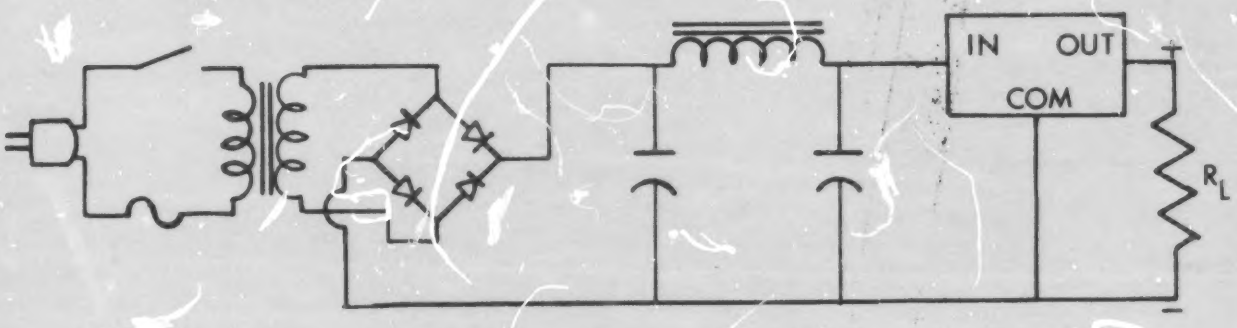
16. Draw the schematic diagram of a power supply using a transformer source, half-wave rectifier, RC L-type filter, resistor load and indicate the polarity of the output voltage. Be sure to switch and fuse the primary circuit.



17. Draw the schematic diagram of a power supply using a transformer source, full-wave rectifier, LC L-type filter, Zener diode regulator, resistor load and indicate the polarity of the output voltage. Be sure to switch and fuse the primary circuit.



18. Draw the schematic diagram of a power supply using a transformer source, bridge rectifier, LC Pi-type filter, IC regulator and a resistor load. Be sure to switch and fuse the primary circuit and indicate the polarity of the output voltage.



TEST X-A-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Place the word or words which best completes the statement in the space provided. Be sure to check your answers.

Half-Wave 1. A/an ____ rectifier circuit requires only one diode.

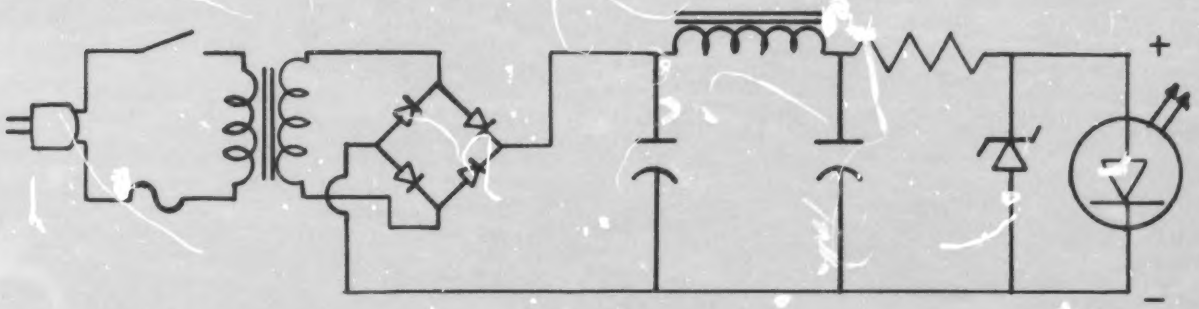
Bridge 2. A/an ____ rectifier requires four diodes and has a full-wave output.

Rectifier 3. A/an ____ circuit is used to convert alternating current into direct current.

Increase 4. Adding a filter circuit to a power supply will cause the output voltage to _____.

Transformer 5. For safety, a/an _____ is used to provide isolation between the electronic circuit and the AC power line.

Directions: Draw the schematic diagram of a power supply using a transformer source, bridge rectifier, LC Pi-type filter, Zener diode regulator and a light emitting diode for a load. Be sure to switch and fuse the primary circuit and indicate the polarity of the output voltage.



INSTRUCTOR'S PLAN
INFORMATIONAL LESSON

X-B-1(I)

SUBJECT:	Amplifier Circuits
AIM:	Upon successful completion of the lesson, the student will be able to draw, construct, analyze and troubleshoot various amplifier circuits.
TEACHING AIDS:	Chalkboard, overhead projector, Transparency Set 19501 figs. 19-26
MATERIALS:	Assignment Sheet - Amplifier Circuits Lab Experiment #47 - The Transistor Test Sheet - Amplifier Circuits
TOOLS AND EQUIPMENT:	Student lab station
REFERENCES:	Schuler, Electronics-Principles and Applications
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

In this lesson you will become familiar with the commonly used amplifier circuits. Most electronic equipment requires the use of several amplifier circuits to operate. You will learn the terminology associated with small signal, power and operational amplifiers. You will also become involved with analyzing the circuits for proper operation. This will help you to further develop your skills in troubleshooting.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Basic Amplifiers	1. Electronic circuits which increase the amplitude of an electronic signal 2. The function of all amplifiers is to provide gain in the circuit 3. Gain is the amount of increase in the signal 4. Gain = signal out / signal in
B. Amplifier Configurations Show Transparency fig. 20	1. Common emitter amplifier a. Good all around amplifier b. Good voltage, current and power gain c. Input impedance - - about 1 K Ohm d. Output impedance - - about 50 K Ohms e. Signal inverted from input to output
Show Transparency fig. 21	2. Common base amplifier a. Good voltage and power gain b. Input impedance - - about 50 Ohms

c. Output impedance - - about 1 M Ohm
d. No signal inversion from input to output

Show Transparency fig. 22

3. Common collector amplifier
   a. Good current and power gain
   b. Input impedance - - about 300 K Ohms
   c. Output impedance - - about 300 Ohms
   d. No signal inversion from input to output

C. Coupling

1. Coupling is providing of a signal path from one amplifier stage to the next

Show Transparency fig. 23

2. Direct coupling
   a. Good for all frequencies down to zero Hertz
   b. No blocking of bias voltages between stages
   c. Requires no additional components

Show Transparency fig. 24

3. Capacitive coupling
   a. Good for lower frequencies
   b. Will not couple DC
   c. Capacitor blocks direct current
   d. Low cost

Show Transparency fig. 25

4. Transformer coupling
   a. Can be used to provide impedance matching
   b. Can be used in tuned circuits for selectivity
   c. Higher cost
   d. Size and weight may be a problem
   e. High efficiency

D. Amplifier Classes

Show Transparency fig. 26

1. Class A operation
   a. 50% efficiency
   b. Very low distortion, excellent for audio
   c. Complete wave reproduced
2. Class AB operation
   a. 65% efficiency
   b. Moderate distortion to wave
   c. Portion of wave not reproduced
3. Class B operation
   a. 75% efficiency
   b. Distorted wave
   c. Portion of wave not reproduced
4. Class C operation
   a. Almost 100% efficient
   b. High distortion
   c. Only a small portion of wave reproduced

E. Power Amplifiers

1. Used to provide more than voltage signal increase
2. Designed for good power gain
3. Must handle large voltage and current values
4. Can be one of the four classes of amplifiers

F. Operational Amplifiers

1. Very useful electronic circuits
2. Characteristics:
   a. Common mode rejection - ability to reduce noise
   b. High input impedance - easier to match impedance
   c. Very high gain - voltage gain can be 200,000 or higher
   d. Low output impedance - easier to match low impedance loads
3. Available as integrated circuit
4. Requires dual voltage power supply (+ and - voltage)
5. Applications
   a. Differential amplifier - amplifies the difference between two signals
   b. Inverting amplifier - inverts the output wave
   c. Summing or subtracting amplifier - adds or subtracts two input signals
   d. Active filter - can be used as a band pass or reject filter

G. Troubleshooting

Show Transparency fig. 19

1. The process of determinging cause of circuit malfunction
2. Troubleshooting steps
   a. Observe symptoms
   b. Analyze possible causes
   c. Limit possibilities
3. Check for proper operation stage-by-stage
4. Replace defective components with equal values

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Amplifier Circuits
2. Experiment #47 - The Transistor
3. Check each student's work for accuracy and completeness

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

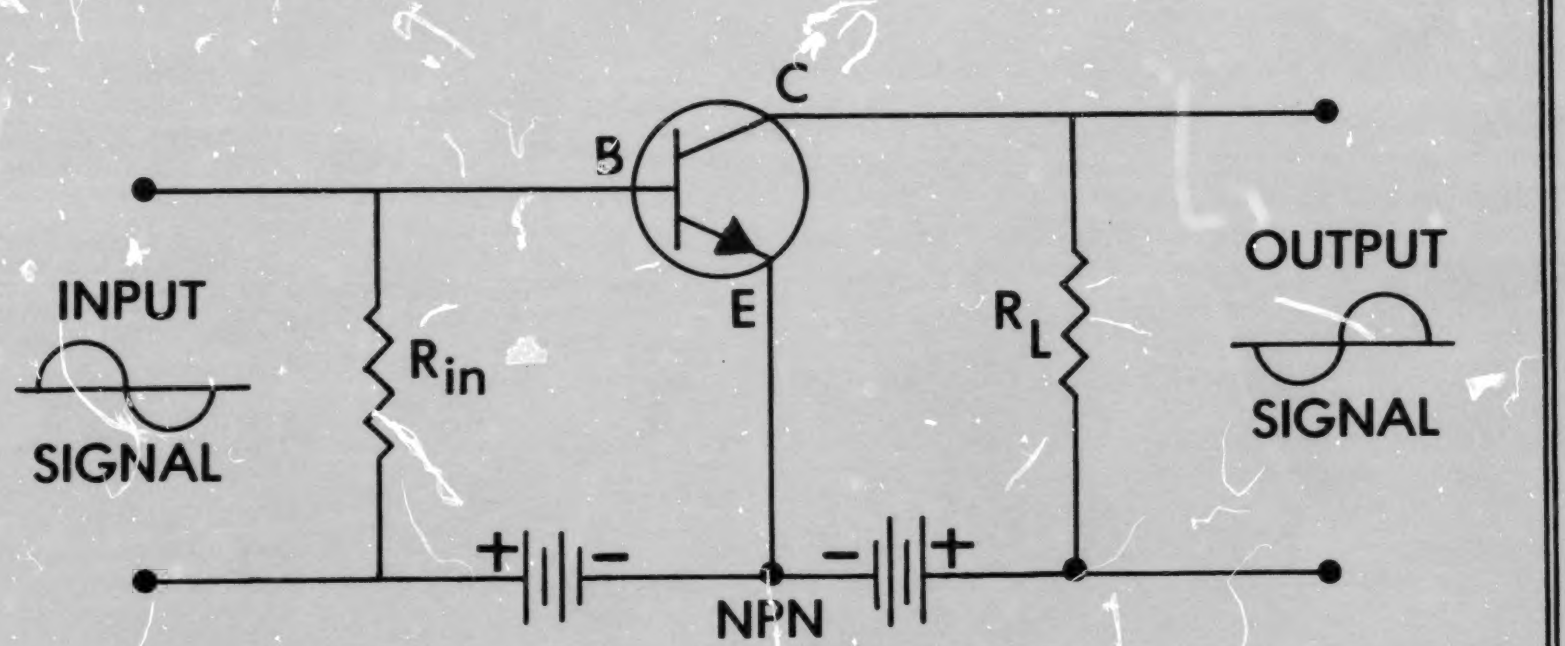
1. Ask oral questions
2. Test Sheet - Amplifier Circuits
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss the test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Oscillator Circuits

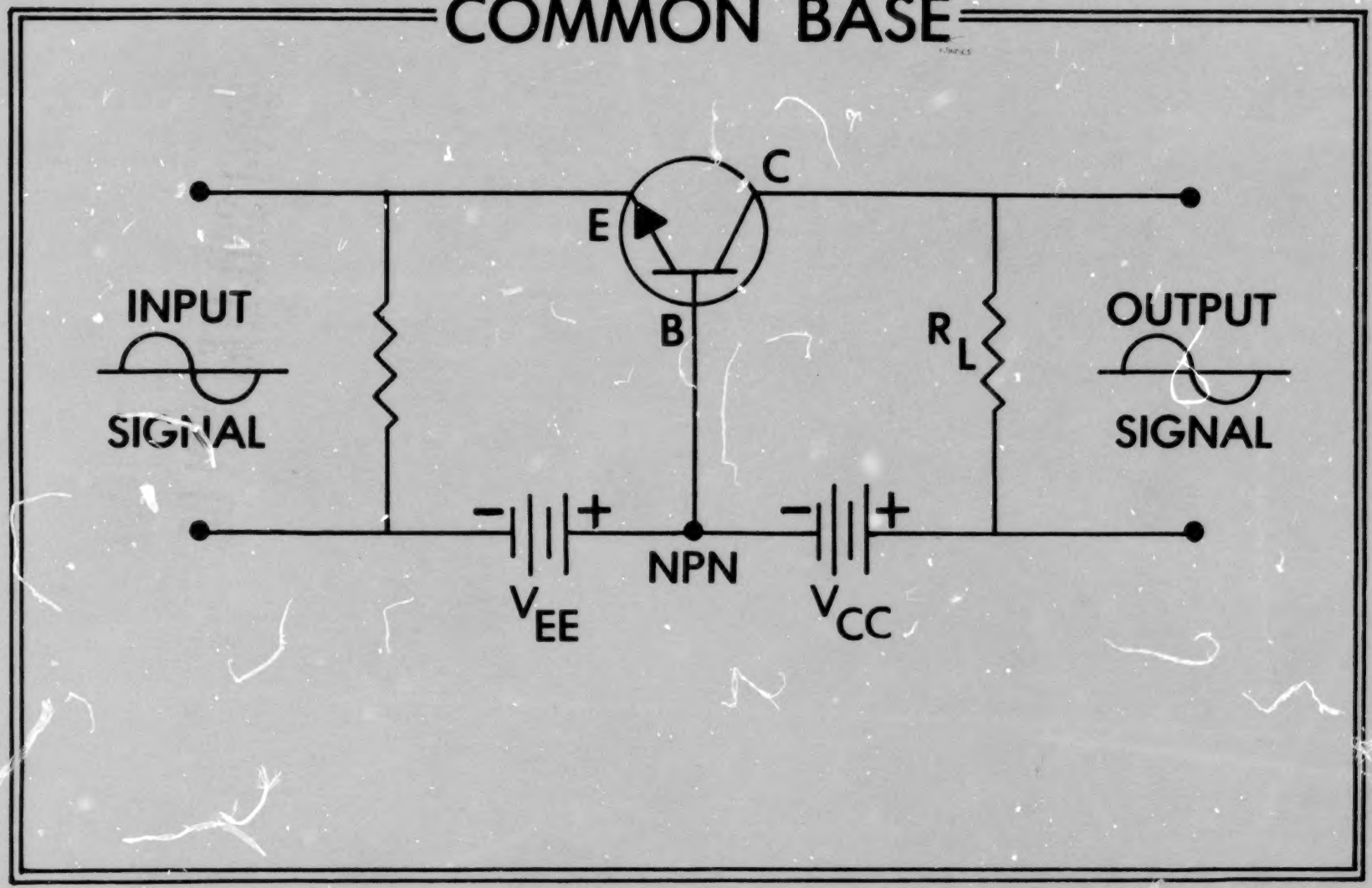
COMMON EMITTER



19501

fig. 20

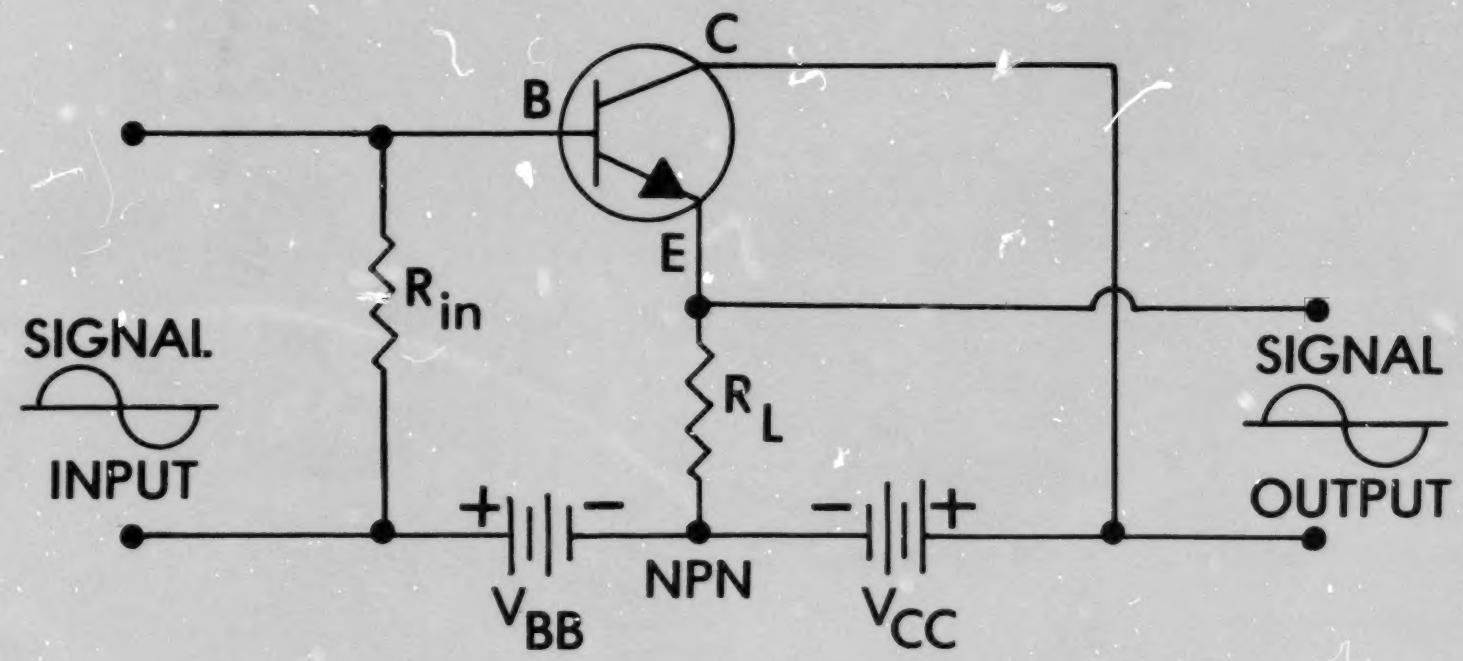
COMMON BASE



19501

fig. 21

COMMON COLLECTOR



DIRECT COUPLING

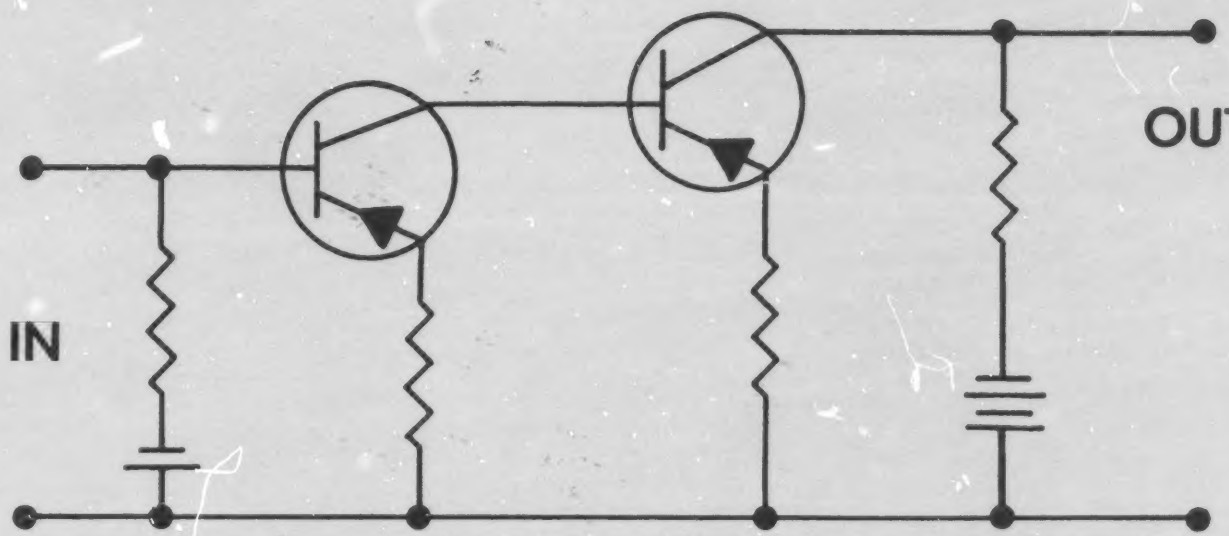


fig. 23

CAPACITIVE COUPLING

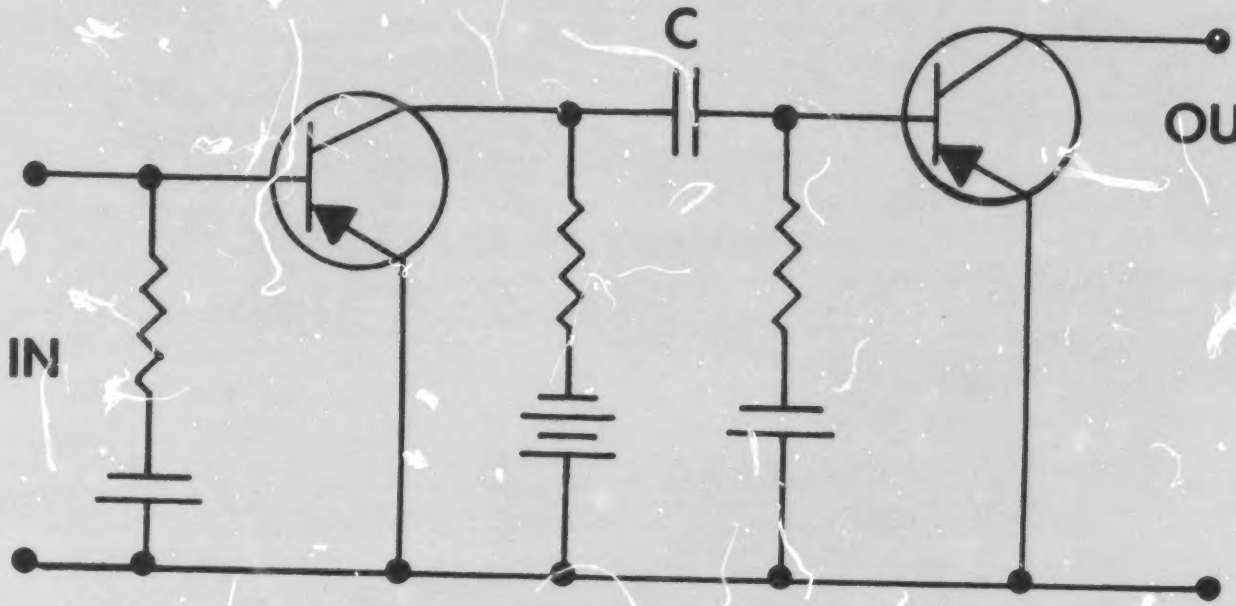
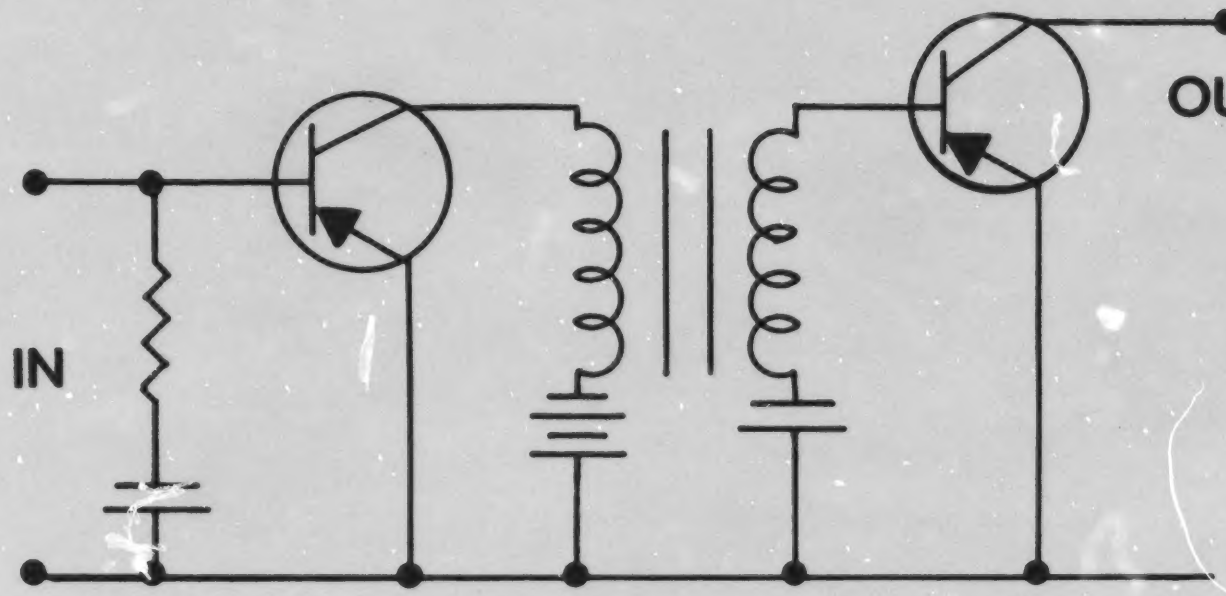
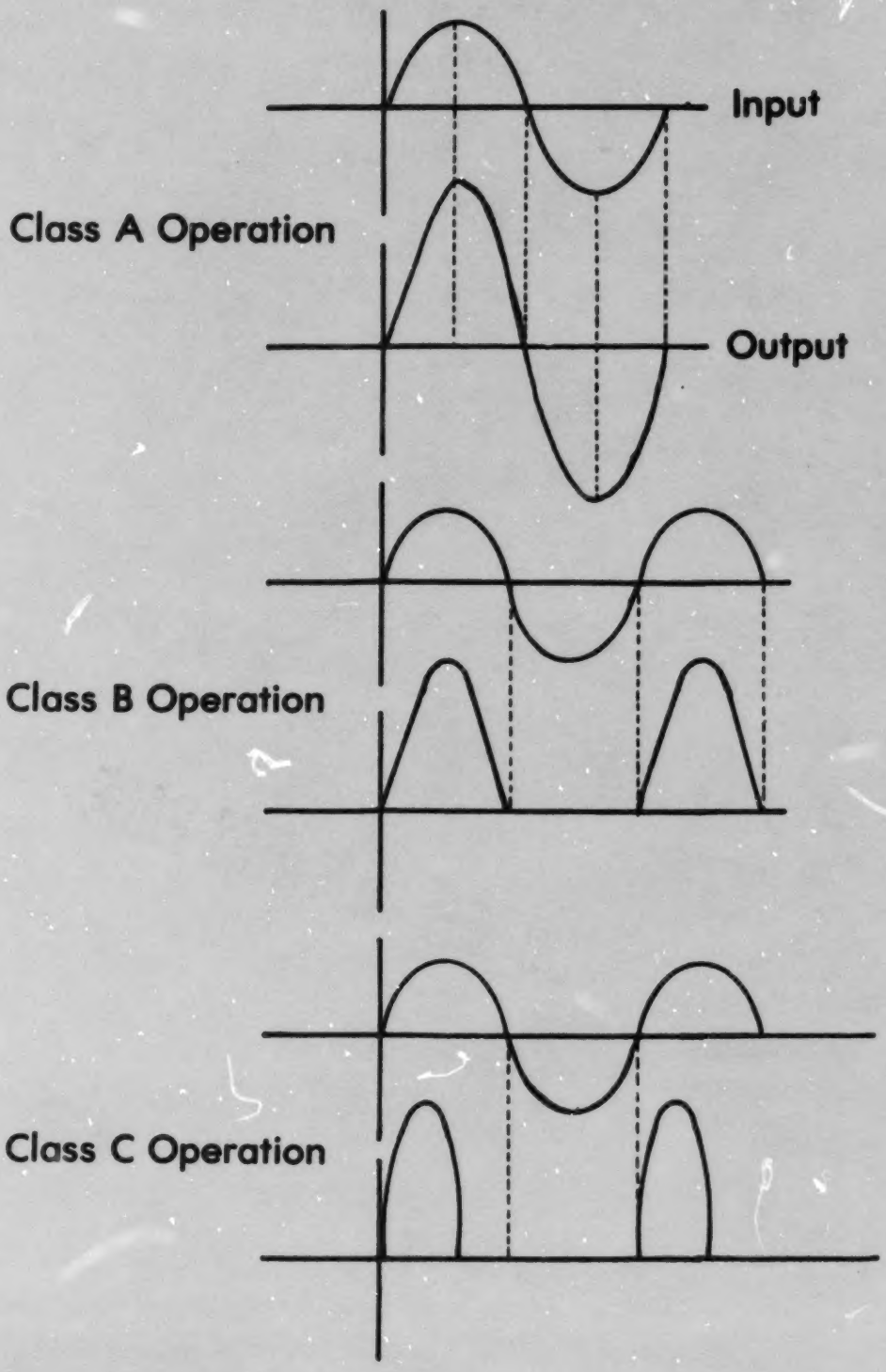


fig. 24

TRANSFORMER COUPLING



AMPLIFIER CLASSES



19501

fig. 26

AMPLIFIER CIRCUITS

X-B-1(AS)
Key

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. You may use your textbook and class notes as reference. Be sure to check you answers. If you have any questions, ask your instructor.

Amplifiers 1. Gain is the basic function of all _____.

Voltage 2. Small signal amplifiers are usually referred to as ____ amplifiers.

Sig out/ Sig in 3. The formula for amplifier gain in terms of signal is _____.

Common-Emitter 4. The ___ amplifier produces a 180° phase inversion.

Common-Emitter 5. The ____ amplifier is the most popular of the three possible configurations.

Very low 6. The common-base amplifier has a ____ input impedance.

Capacitive 7. The three basic types of amplifier coupling are ____, ____, and _____.

Direct 8.

Transformer 9.

Class C 10. The most efficient class of amplifier is the _____.

Class A 11. The class of amplifier with the least amount of distortion is the _____.

Class A 12. The least efficient class of amplifier is the _____.

Differential 13. A _____ amplifier responds to the difference between two input signals.

Inverting 14. Operational amplifiers have two inputs, a/an _____ and a/an _____.

Noninverting 15.

Troubleshooting 16. When ____, remember to check all connections and control settings.

Intermittent 17. An electronic device is _____ when it will work only some of the time.

Duel 18. Most operational amplifiers require _____ voltage power supplies.

Limiting the possibilities 19. Making a resistance measurement of a component is part of the _____ stage of the troubleshooting process.

Logical 20. Good troubleshooting is a ____ and orderly process.

TEST X-B-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

Voltage 1. Small signal amplifiers are usually referred to as _____ amplifiers.

Amplifiers 2. Gain is the basic function of all _____.

Common-Emitter 3. The ____ amplifier produces a 180° phase inversion.

Capacitive 4. The three basic types of amplifier coupling are ____, ____, and ____.

Direct 5.

Transformer 6.

Class C 7. The most efficient class of amplifier is the ____.

Class A 8. The class of amplifier with the least amount of distortion is the _____.

Differential 9. A _____ amplifier responds to the difference between two input signals.

Inverting 10. Operational amplifiers have two inputs, a/an _____ and a noninverting.

Operational 11. Most ____ amplifiers require duel voltage power supplies.

Directions: Match the item in column A with the item in column B. Write the letter representing your answer in the space provided.

	Column A	Column B
D	12. Class A	A. Operates at cut off
A	13. Class B	B. Extreme Distortion
C	14. Class AB	C. High Power Audio Work
B	15. Class C	D. Low Distortion

INSTRUCTOR'S PLAN
INFORMATIONAL LESSON

X-C-1(I)

SUBJECT:	Oscillator Circuits
AIM:	Upon successful completion of the lesson, the student will be able to demonstrate an understanding of oscillator circuits by analyzing circuits and answering questions.
TEACHING AIDS:	Chalkboard, overhead projector, Transparency Set 19501, figs. 27-30
MATERIALS:	Assignment Sheet - Oscillator Circuits Test Sheet - Oscillator Circuits
TOOLS AND EQUIPMENT:	Student lab station
REFERENCES:	Schuler, Electronics-Principles and Applications
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Oscillator circuits are used in electronics as a source of signals to be processed within systems. There are many oscillator circuits in use, each offering certain advantages. In this lesson, we will study the ones most commonly used. As you continue your study of electronics, the need to have a good understanding of how oscillators function is very important.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Characteristics	1. Oscillators convert direct current to alternating current 2. They produce AC waves 3. Two types: a. Sinusoidal - sine wave b. Nonsinusoidal - any wave shape not sine wave 4. Feedback - output allowed to enter the input of an amplifier 5. Regenerative feedback - positive feedback - inphase feedback 6. Stability - The characteristic of an oscillator to have an output with constant frequency and amplitude 7. RC tank circuits - parallel circuits with a maximum output at a certain frequency 8. Resonant frequency - frequency of tank circuit oscillation

B. Oscillator Types

Show Transparency fig. 27

1. Crystal oscillator
   a. Uses quartz crystal to control frequency
   b. Quartz crystals are piezoelectric devices
   c. High frequency stability

Show Transparency fig. 28

2. Astable multivibrator
   a. A type of relaxation oscillator
   b. Has no stable states, circuit voltage switches constantly as circuit oscillates
   c. Called a freerunning flip-flop because of the back and forth switching action of the two transistors
   d. Frequency controlled by RC time constants of the circuit components

Show Transparency fig. 29

3. Timers
   a. Integrated circuits designed to act as oscillators
   b. Most are very effective oscillators
   c. Use external resistor and capacitor to determine frequency

Show Transparency fig. 30

4. Others
   a. Hartley oscillator - uses tapped coil in tank circuit to determine frequency
   b. Colpitts oscillator - uses dual adjustable capacitors to determine frequency
   c. Clapp oscillator - similar to Colpitts except uses series inductor and adjustable capacitor to determine frequency

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Oscillator Circuits
2. Check each student's work for accuracy and completeness
3. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

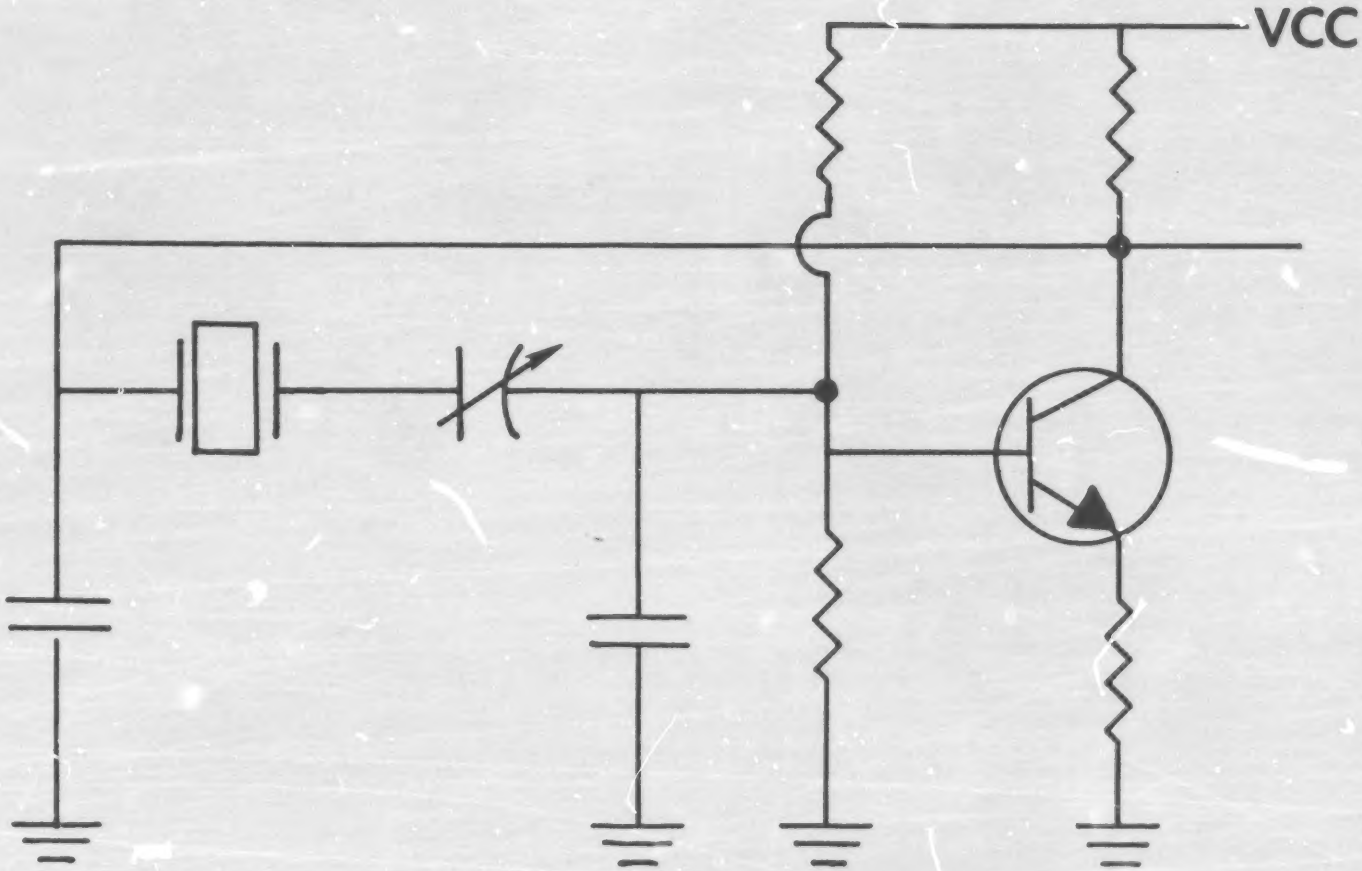
1. Ask oral questions
2. Test Sheet - Oscillator Circuits
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss the test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Digital Introduction

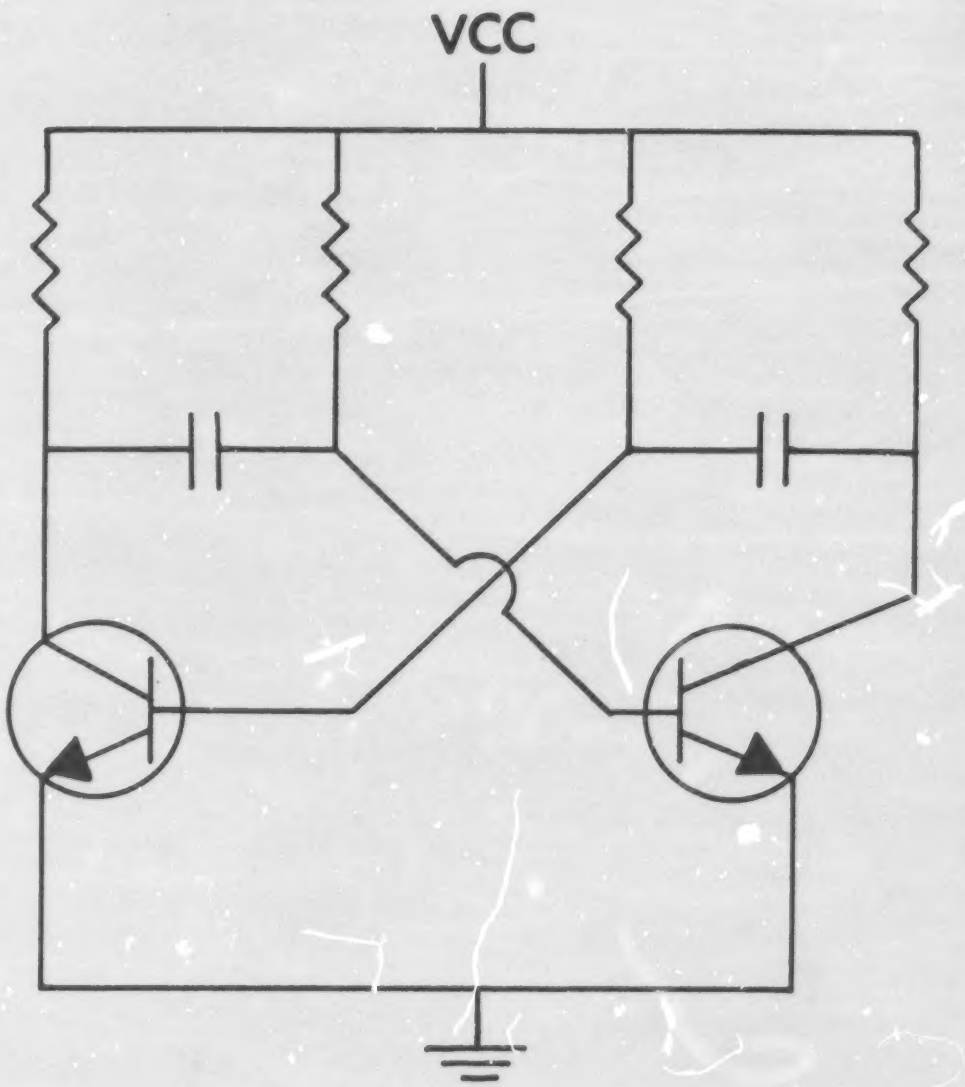
CRYSTAL OSCILLATOR



19501

fig. 27

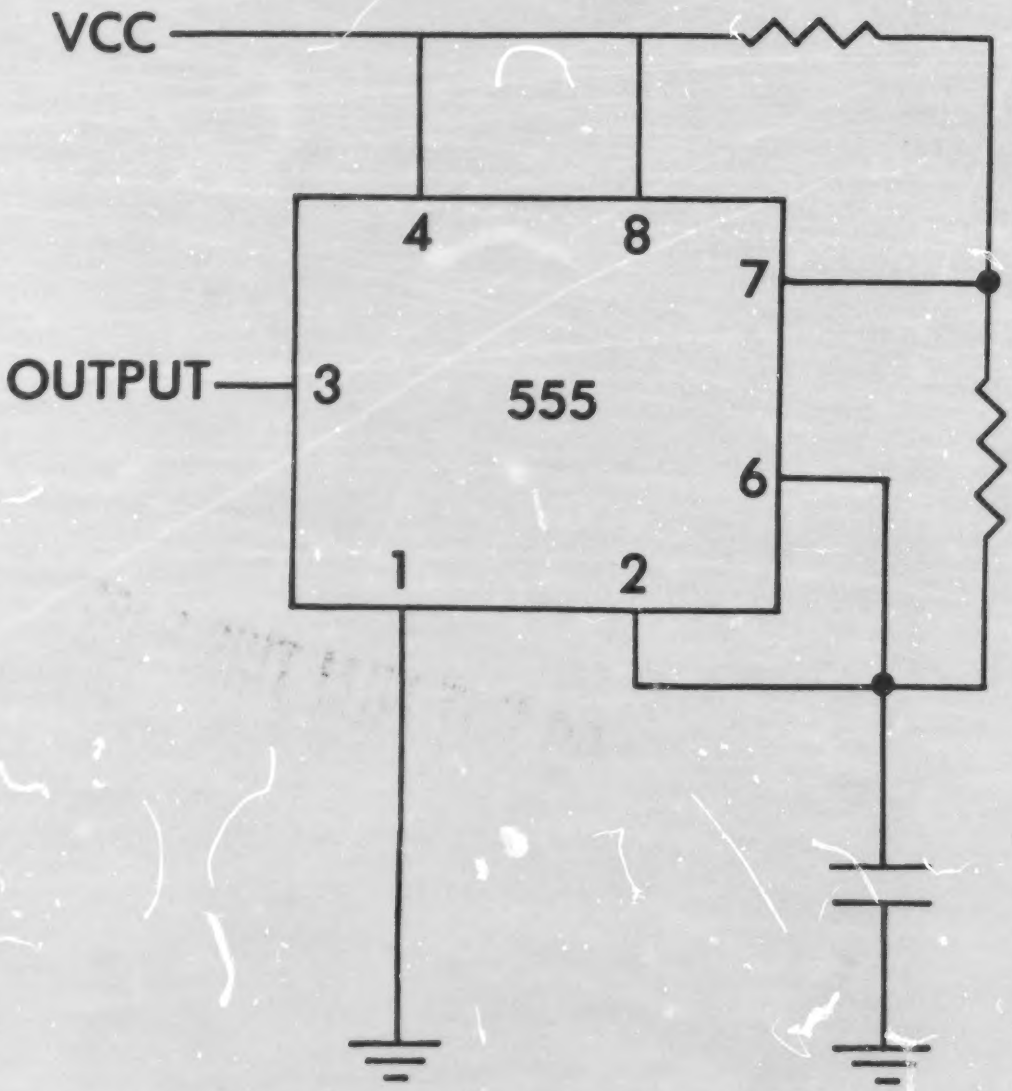
ASTABLE MULTIVIBRATOR



19501

fig. 28

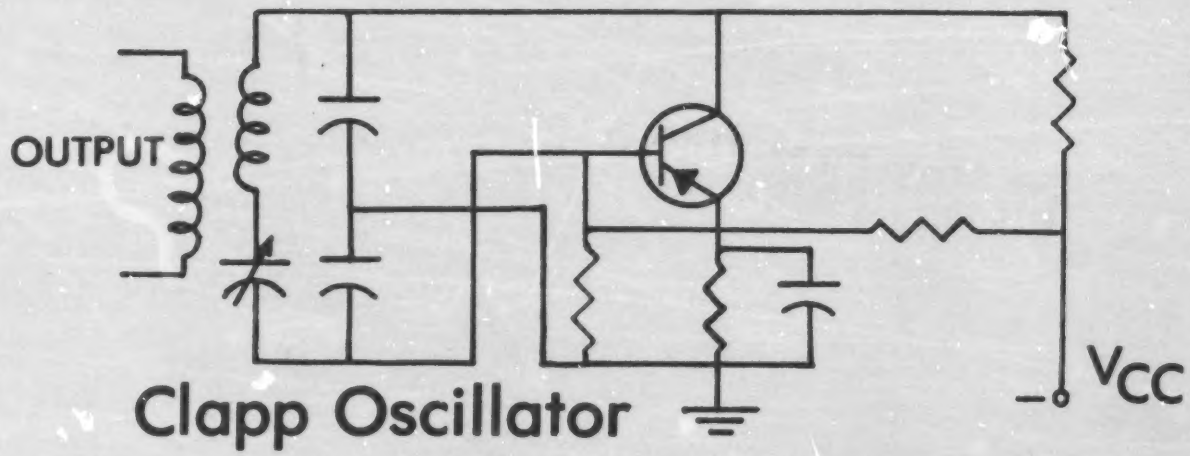
TIMER



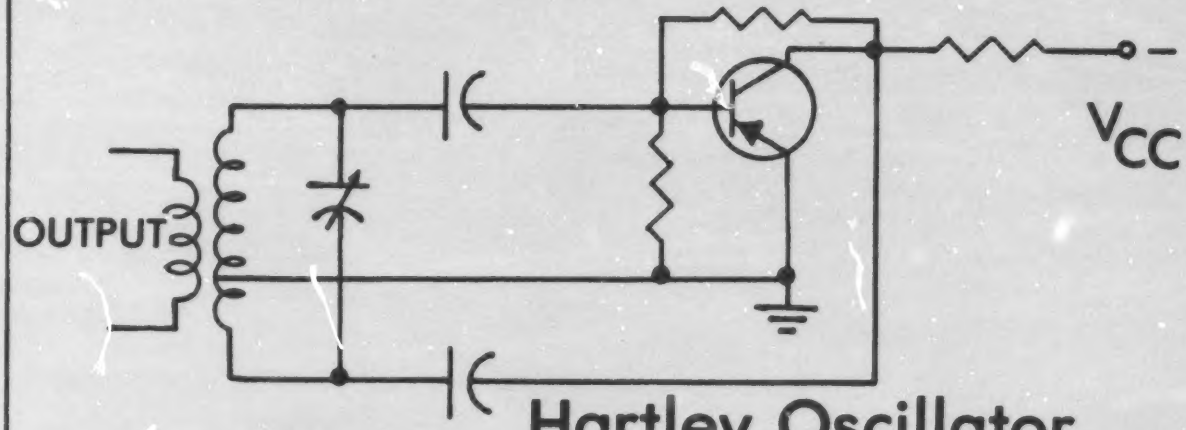
19501

fig. 29

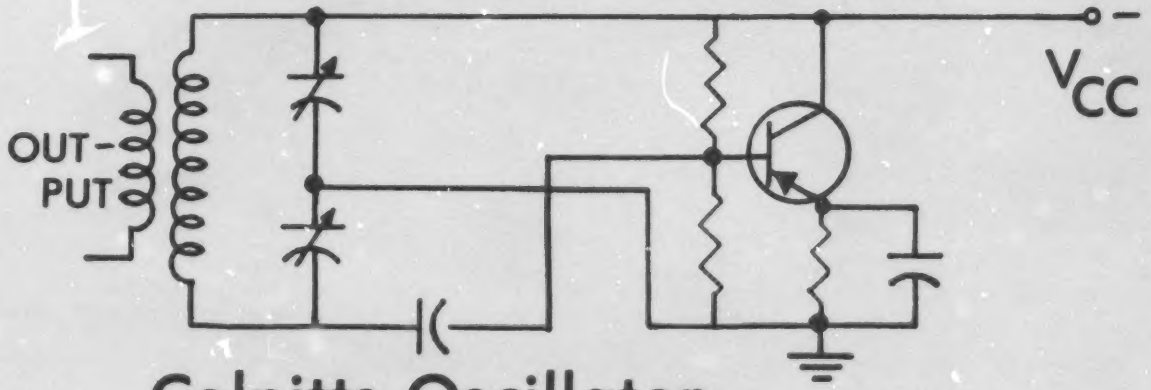
OSCILLATORS



Clapp Oscillator



Hartley Oscillator



Colpitts Oscillator

OSCILLATOR CIRCUITS

X-C-1(AS)
Key

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. You may use your textbook and class notes as reference. Be sure to check your answers. If you have any questions, ask your instructor.

Generate 1. An oscillator is an electronic circuit used to ___ an AC signal.

Feedback 2. An amplifier with positive ____ will act as an oscillator.

False 3. All oscillator circuits produce sinusoidal waves. (True/False)

Regenative 4. Positive or in phase feedback is also called ____ feedback.

Variable Frequency Oscillator 5. An adjustable oscillator is called a _____.

Resonant 6. An RC or RL tank circuit will have a/an ____ frequency.

Hartley 7. A/an ____ oscillator uses a tank circuit with a tapped coil.

Colpitts 8. A/an ____ oscillator uses a tank circuit with two capacitors to provide a center tap.

Clapp 9. To increase stability, a Colpitts oscillator can be series tuned to make a _____ circuit.

In phase 10. An amplifier will oscillate if provided with ____ feedback.

Quartz 11. A/an ____ crystal can be used to control the frequency of an oscillator circuit.

Buffer 12. To improve stability, a/an ____ amplifier can be placed between oscillators and other circuits.

Square 13. An astable multivibrator circuit produces a ____ wave shape.

Transistors 14. The astable multivibrator uses two ____ and RC time constants to determine frequency.

Damped 15. A tank circuit will produce a/an ____ sine wave.

Repetitive 16. Most oscillators produce a _____ AC signal.

Crystal 17. If high frequency stability is required, a/an ____ controlled oscillator should be used.

Frequency 18. Changes in temperature can cause changes in oscillator _____.

True 19. An oscillator can be an amplifier that provides its own input signal. (True/False)

Loading 20. Connecting test equipment to oscillator circuits can cause _____ effect.

TEST X-C-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

Hartley 1. A/an ___ oscillator uses a tank circuit with a tapped coil.

Regenative 2. Positive or in phase feedback is also called _____ feedback.

False 3. All oscillator circuits produce sinusoidal waves. (True/False)

Feedback 4. An amplifier with positive ___ will act as an oscillator.

Quartz 5. A/an ___ crystal can be used to control the frequency of an oscillator circuit.

Generate 6. An oscillator is an electronic circuit used to _____ an AC signal.

Resonant 7. An RC or RL tank circuit will have a/an ___ frequency.

Colpitts 8. A/an ___ oscillator uses a tank circuit with two capacitors to provide a center tap.

Crystal 9. If high frequency stability is required, a/an ___ controlled oscillator should be used.

Temperature 10. Changes in ___ can cause changes in oscillator frequency.

INSTRUCTOR'S PLAN
INFORMATIONAL LESSON

XI-A-1(I)

SUBJECT:	Digital Introduction
AIM:	Upon successful completion of the lesson, the student will be able to demonstrate an understanding of the advantages, applications and the binary number system of digital circuits by answering questions.
TEACHING AIDS:	Chalkboard, overhead projector, Transparency Set 19501, figs. 31-32
MATERIALS:	Assignment Sheet - Digital Introduction Test Sheet - Digital Introduction
TOOLS AND EQUIPMENT:	None
REFERENCES:	Tokheim, Roger, Digital Electronics, McGraw-Hill Gregg Division, New York, 1979
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Digital electronics is a specialized area of electronics which has become more and more popular in recent years. Today, digital circuits are being used in all types of equipment. The pocket calculator, digital watch, microwave oven, biomedical equipment, video game and computer are only a few. Today's technician and engineer must have a solid understanding of this area. In this lesson you will learn the advantages, applications and binary number system of digital circuits.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS		THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A.	Definitions	1. Analog - continuously variable signal, can have any value 2. Digital - having two conditions, example: on and off or 0 V and 5 V 3. Digital signals are switched between two levels 4. Square wave digital signals have high-low or logic 1-logic 0 condition
B.	Applications	1. Calculators (pocket and desk top) 2. Computers (personal and business) 3. Indicators on everything from radios to microwave ovens 4. Watches and clocks 5. Biomedical equipment 6. Automobiles

C. Advantages

1. Accurate
2. Low power
3. Fast
4. Compact circuits - many integrated circuits

D. Binary Numbers

Show Transparency fig. 31

1. Number system using two symbols
2. Also called base 2 number system
3. Each binary digit (Bit) can only have a value of 0 or 1
4. Least significant bit (LSB) is on the right
5. Most significant bit (MAS) is on the left
6. Values increase from left to right by a power of 2

Show Transparency fig. 32

7. Position powers $2^4, 2^3, 2^2, 2^1, 2^0$
   $16, 8, 4, 2, 1$
8. Each bit that is one is to be added
9. Binary to decimal conversion
   $11011 = 1(16) + 1(8) + 0(4) + 1(2) + 1(1) = 27$

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Digital Introduction
2. Check each student's work for accuracy and completeness
3. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

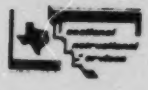
1. Ask oral questions
2. Test Sheet - Digital Introduction
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss the test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Logic Gates

DECIMAL	BINARY
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001



19501

fig. 31

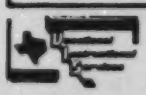
POSITION POWERS

2^4	2^3	2^2	2^1	2^0
16	8	4	2	1

BINARY TO DECIMAL NUMBER CONVERSION

11011

$$1(16)+1(8)+0(4)+1(2)+1(1)=27$$



19502

fig. 32

DIGITAL INTRODUCTION XI-A-1(AS)
Key

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. You may use your textbook and class notes as reference. Be sure to check your answers. If you have any questions, ask your instructor.

Digital 1. A/an ___ circuit has only two signal values.

Computers 2. List six common applications of digital circuits.

Digital Watches 3.

Automobiles 4.

Microwave Ovens 5.

Radios 6.

Calculators 7.

Fast 8. List three advantages of digital circuits.

Compact 9.

Low power 10.

Directions: Convert the following numbers and write your answer in the space provided. Be sure to check your answers.

11 11. 1011 Binary to Decimal

15 12. 1111 Binary to Decimal

7 13. 0111 Binary to Decimal

11011 14. 27 Decimal to Binary

01001 15. 9 Decimal to Binary

TEST XI-A-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

Compact 1. List two advantages of digital circuits.

Low power 2.

Two 3. A digital circuit has only ____ signal values.

Computers 4. List four common applications of digital circuits.

Digital Watches 5.

Microwave Ovens 6.

Calculators 7.

Directions: Convert the following numbers and write your answer in the space provided. Be sure to check your answers.

11 8. 1011 Binary to Decimal

5 9. 0101 Binary to Decimal

8 10. 1000 Binary to Decimal

15 11. 1111 Binary to Decimal

7 12. 0111 Binary to Decimal

11010 13. 26 Decimal to Binary

01011 14. 11 Decimal to Binary

01101 15. 13 Decimal to Binary

INSTRUCTOR'S PLAN XI-B-1(I)
INFORMATIONAL LESSON

SUBJECT:	Digital Logic Gates
AIM:	Upon successful completion of the lesson, the student will be able to demonstrate an understanding of the seven basic logic gates including symbol, function, Boolean expression and truth table.
TEACHING AIDS:	Chalkboard, overhead projector, Transparency Set 19501, figs. 33-39
MATERIALS:	Assignment Sheet - Digital Logic Gates Experiment #3 - Binary Logic Gates Test Sheet - Digital Logic Gates
TOOLS AND EQUIPMENT:	Student lab station
REFERENCES:	Tokheim, Roger, Digital Electronics, McGraw-Hill Gregg Division, New York, 1979 Tokheim, Roger, Activities Manual for Digital Electronics, McGraw-Hill Gregg Division, New York, 1979
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

In this lesson, you will learn the basic components of digital electronics. These are called binary logic gates. A solid understanding of these components, their functions, and truth tables will help you to master this popular type of electronic circuits. You will actually work with typical components packaged as integrated circuits.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. AND Gate Show Transparency fig. 33	1. Logic symbol 2. Input A and input B must be logic high to get a logic high output 3. Truth table 4. Boolean expression a. Dot is AND symbol b. A . B = Y
B. OR Gate Show Transparency fig. 34	1. Logic symbol 2. Input A or input B must be logic high to get a logic high output 3. Truth table 4. Boolean expression a. + is OR symbol b. A + B = Y

C. Inverters
Show Transparency fig. 35

1. Logic symbol
2. Gives output NOT the same as input (NOT Gate)
3. Truth table
4. Boolean expression
   a. Bar is NOT symbol
   b. $A = \overline{A}$

D. NAND Gate
Show Transparency fig. 36

1. Logic symbol
2. NOT AND gate - acts as an AND gate with inverted output
3. Truth table
4. Boolean expression: $\overline{A \cdot B} = Y$

E. NOR Gate
Show Transparency fig. 37

1. Logic symbol
2. NOT OR gate - acts as an OR gate with inverted output
3. Truth table
4. Boolean expression: $\overline{A + B} = Y$

F. XOR Gate
Show Transparency fig. 38

1. Logic symbol
2. Exclusive OR gate - any high input will give a high output, but all inputs cannot be high
3. Truth table
4. Boolean expression: $A \oplus B = Y$

G. XNOR Gate
Show Transparency fig. 39

1. Logic symbol
2. Exclusive NOT OR gate - any high input will give an inverted output, but all inputs cannot be high
3. Truth table
4. Boolean expression: $\overline{A \oplus B} = Y$

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Digital Logic Gates
2. Experiment #3 - Binary Logic Gates
3. Check each student's work for accuracy and completeness
4. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

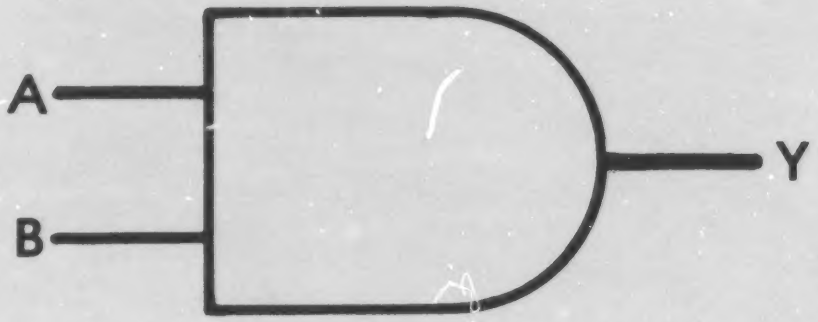
1. Ask oral questions
2. Test Sheet - Digital Logic Gates
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss the test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Sequential Logic Circuits

AND Gate



$$A \cdot B = Y$$

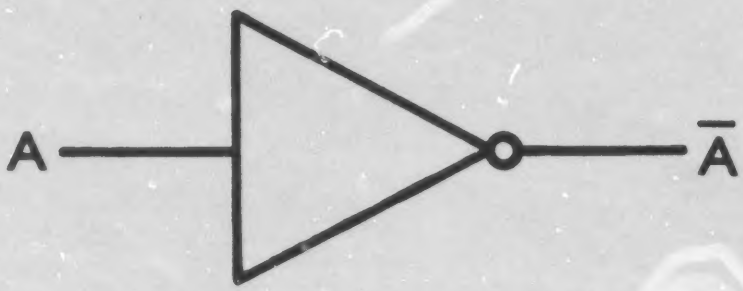
Inputs		Outputs
A	B	Y
0	0	0
1	0	0
0	1	0
1	1	1

OR Gate

$$A + B = Y$$

Inputs		Outputs
A	B	Y
0	0	0
1	0	1
0	1	1
1	1	1

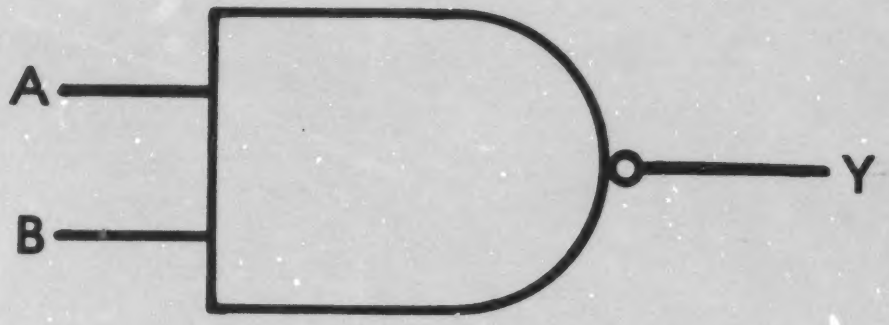
Inverter



$$A = \overline{A}$$

Inputs		Outputs
A	B	Y
0		1
1		0

NAND Gate



$$\overline{A \cdot B} = Y$$

Inputs		Outputs
A	B	Y
0	0	1
1	0	1
0	1	1
1	1	0

NOR Gate

$$\overline{A + B} = Y$$

Inputs		Outputs
A	B	Y
0	0	1
1	0	0
0	1	0
1	1	0

XOR Gate

$$A \oplus B = Y$$

Inputs		Outputs
A	B	Y
0	0	0
1	0	1
0	1	1
1	1	0

XNOR Gate

$$\overline{A \oplus B} = Y$$

Inputs		Outputs
A	B	Y
0	0	1
1	0	0
0	1	0
1	1	1

DIGITAL LOGIC GATES

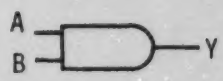
XI-B-1(AS)
Key

Name _____ Date _____

Directions: For each of the seven logic gates, draw the schematic symbol, the truth table and write the Boolean expression. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

1. AND Gate:

Symbol



Truth Table

Inputs		Outputs
A	B	Y
0	0	0
1	0	0
0	1	0
1	1	1

Boolean Expression

$A \cdot B = Y$

2. OR Gate:

Symbol

Truth Table

Inputs		Outputs
A	B	Y
0	0	0
1	0	1
0	1	1
1	1	1

Boolean Expression

$A + B = Y$

3. NOT Gate:

Symbol

Truth Table

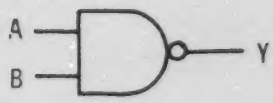
Inputs		Outputs
A	B	Y
0		1
1		0

Boolean Expression

$A = \overline{A}$

4. NAND Gate:

Symbol



Truth Table

Inputs		Outputs
A	B	Y
0	0	1
1	0	1
0	1	0
1	1	0

Boolean Expression

$\overline{A \cdot B} = Y$

5. **NOR Gate:**

Symbol

Truth Table

Inputs		Outputs
A	B	Y
0	0	1
1	0	0
0	1	0
1	1	0

Boolean Expression

$$\overline{A + B} = Y$$

6. **XOR Gate:**

Symbol

Truth Table

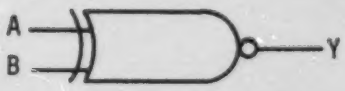
Inputs		Outputs
A	B	Y
0	0	0
1	0	1
0	1	1
1	1	0

Boolean Expression

$$A \oplus B = Y$$

7. **XNOR Gate:**

Symbol



Truth Table

Inputs		Outputs
A	B	Y
0	0	1
1	0	0
0	1	0
1	1	1

Boolean Expression

$$\overline{A \oplus B} = Y$$

TEST XI-B-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

AND 1. The ___ gate must have both inputs at logic high to have an output that is high.

OR 2. Either input must be high to have a high output in a/an ___ gate.

Inverter 3. A/an ___ gate complements the input.

NOT 4. An inverter is also known as a/an ___ gate.

NAND 5. The universal gate is the ___ gate.

+ (plus sign) 6. The ___ is the Boolean symbol for OR.

OR 7. The Boolean expression, A + B = Y represents the ___ gate.

Inverted 8. The NOR gate acts as an OR gate except the output is ___.

$\overline{\oplus}$ 9. The logic symbol for an XNOR gate is _____.

10. Complete the following truth table for a NAND Gate.

INPUTS		OUTPUT
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

INSTRUCTOR'S PLAN
INFORMATIONAL LESSON

XI-C-1(I)

SUBJECT:	Sequential Logic Circuits
AIM:	Upon successful completion of the lesson, the student will be able to demonstrate an understanding of sequential logic circuits including flip-flops, counter, registers and arithmetic circuits.
TEACHING AIDS:	Chalkboard, overhead projector, Transparency Set 19501, figs. 40-46
MATERIALS:	Assignment Sheet - Sequential Logic Circuits Experiment #6 - Flip-Flops Experiment #7 - Counters Experiment #8 - Shift Registers Experiment #9 - Arithmetic Circuits Test Sheet - Sequential Logic Circuits
TOOLS AND EQUIPMENT:	Student lab station
REFERENCES:	Tokheim, Roger, Digital Electronics, McGraw-Hill Gregg Division, New York, 1979 Tokheim, Roger, Activities Manual for Digital Electronics, McGraw-Hill Gregg Division, New York, 1979
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

We will continue the study of digital electronics in this lesson. Logic circuits can be divided into two types, combinational and sequential. We studied combinational logic circuits in the last lesson. Flip-flops, counters, registers and arithmetic circuits are commonly used in circuits. They are usually in the form of integrated circuits to allow you, as the technican or engineer, unlimited flexibility in circuit design and repair. An understanding of these circuits will give you an advantage working with digital equipment.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. RS Flip-Flop Show Transparency fig. 40	1. Logic symbol 2. Outputs Q and not $\overline{Q}$ toggle (flip-flop) with logic high or set or reset input 3. Truth table 4. Timing diagram
B. JK Flip-Flop Show Transparency fig. 41	1. Logic symbol 2. Most commonly used with preset and clear inputs added 3. Truth table

C. Counters
Show Transparency fig. 42
Show Transparency fig. 43

1. Block diagram
2. Clock input causes the count sequence
3. Counters can count up or down
4. Sometimes used for frequency division
5. Function table

D. Shift Registers
Show Transparency fig. 44
Show Transparency fig. 45

1. Block diagram
2. Are used as a temporary memory
3. Used to hold numbers on display after key is released
4. Shifts numbers in display as needed
5. Truth table
6. Waveforms

E. Half Adder
Show Transparency fig. 46

1. Diagram
2. Is the basic addition circuit
3. Two can be used with an OR gate to make a full adder
4. Truth table

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Sequential Logic Circuits
2. Experiment #6 - Flip-Flops
3. Experiment #7 - Counters
4. Experiment #8 - Shift Registers
5. Experiment #9 - Arithmetic Circuits
6. Check each student's work for accuracy and completeness
7. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

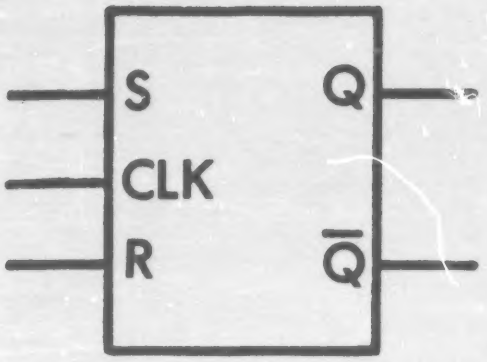
1. Ask oral questions
2. Test Sheet - Sequential Logic Circuits
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss the test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Communications Systems

RS FLIP-FLOP

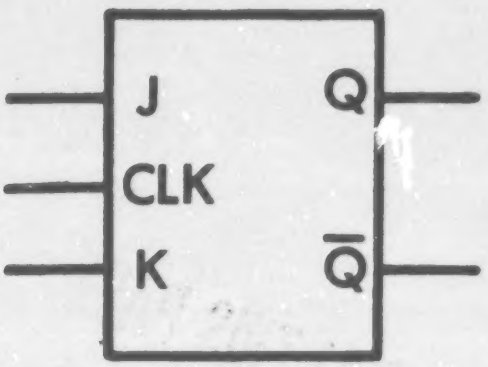


CLK	INPUTS S	INPUTS R	OUTPUTS Q	OUTPUTS $\overline{Q}$
⊓	0	0	NO CHANGE	
⊓	0	1	0	1
⊓	1	0	1	0
⊓	1	1	PROHIBITED	

19501

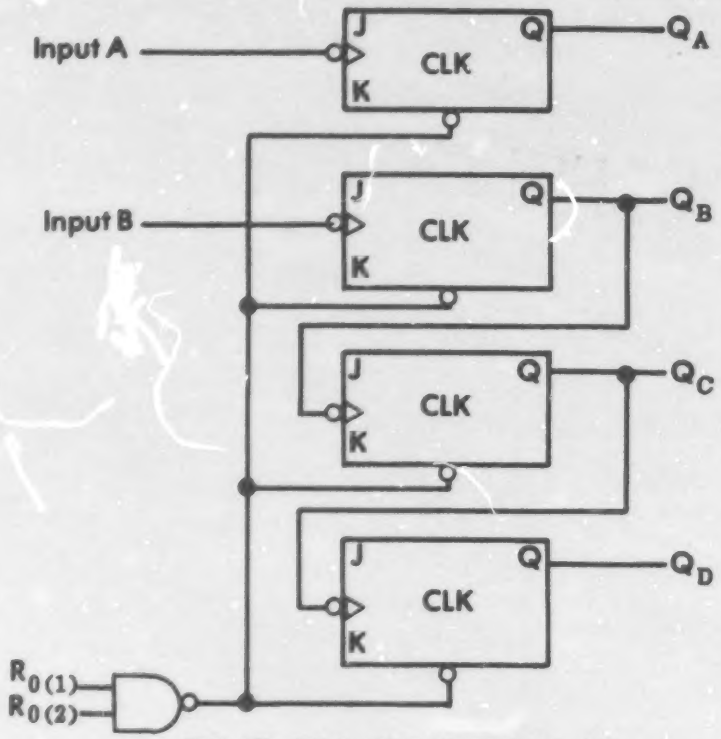
fig. 40

JK FLIP-FLOP

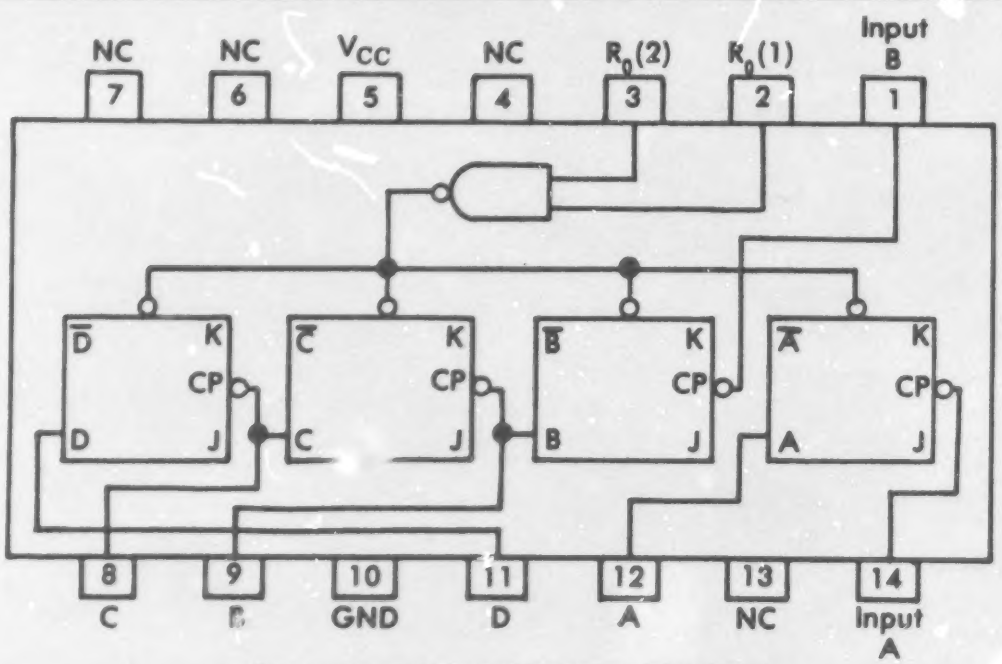


CLK	INPUTS J	INPUTS K	OUTPUTS Q	OUTPUTS $\overline{Q}$
⊓	0	0	DISABLE	
⊓	0	1	0	1
⊓	1	0	1	0
⊓	1	1	TOGGLE	

COUNTERS



BLOCK DIAGRAM



PIN CONFIGURATION

COUNTERS

COUNT	OUTPUT			
	Q_D	Q_C	Q_B	Q_A
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
10	H	L	H	L
11	H	L	H	H
12	H	H	L	L
13	H	H	L	H
14	H	H	H	L
15	H	H	H	H

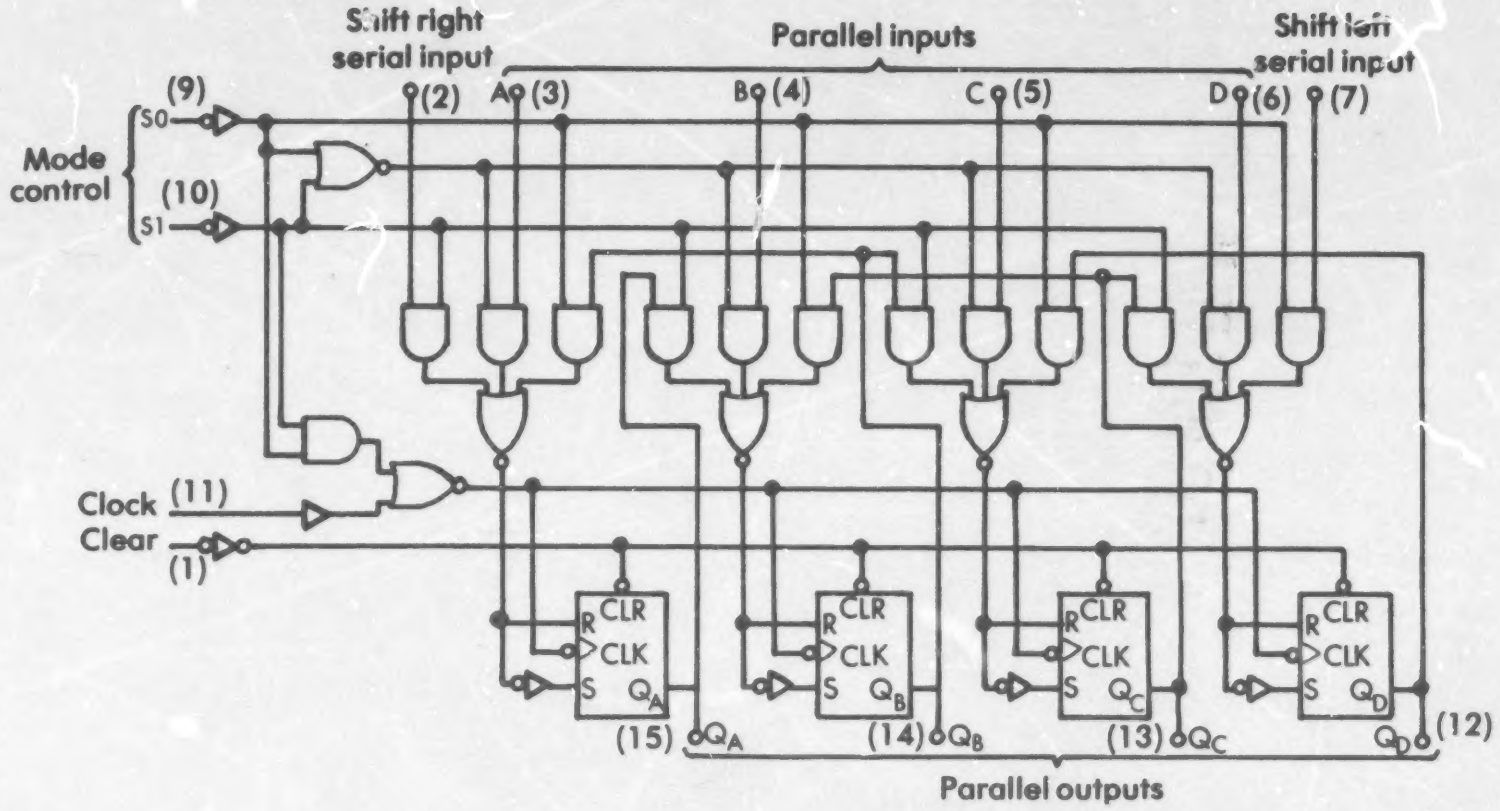
COUNT SEQUENCE

RESET INPUTS		OUTPUT			
$R_0(1)$	$R_0(2)$	Q_D	Q_C	Q_B	Q_A
H	H	L	L	L	L
L	X	Count			
X	L	Count			

RESET/COUNT FUNCTION TABLE

SHIFT REGISTERS

BLOCK DIAGRAM

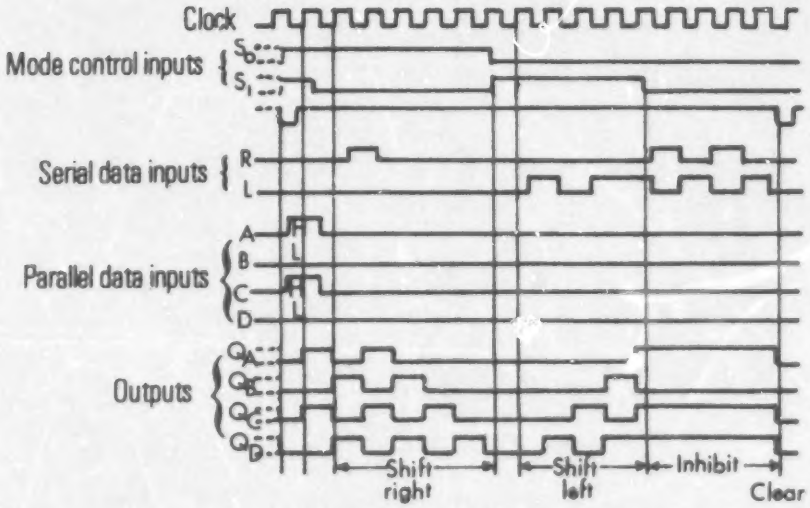


SHIFT REGISTERS

INPUTS										OUTPUTS			
CLEAR	MODE		CLOCK	SERIAL		PARALLEL				Q_A	Q_B	Q_C	Q_D
	S1	S2		LEFT	RIGHT	A	B	C	D				
L	X	X	X	X	X	X	X	X	X	L	L	L	L
H	X	X	L	X	X	X	X	X	X	Q_{AO}	Q_{BO}	Q_{CO}	Q_{DO}
H	H	H	↑	X	X	a	b	c	d	a	b	c	d
H	L	H	↑	X	H	X	X	X	X	H	Q_{An}	Q_{Bn}	Q_{Cn}
H	L	H	↑	X	L	X	X	X	X	L	Q_{An}	Q_{Bn}	Q_{Cn}
H	H	L	↑	H	X	X	X	X	X	Q_{Bn}	Q_{Cn}	Q_{Dn}	H
H	H	L	↑	L	X	X	X	X	X	Q_{Bn}	Q_{Cn}	Q_{Dn}	L
L	L	L	X	X	X	X	X	X	X	Q_{AO}	Q_{BO}	Q_{CO}	Q_{DO}

H = high level (steady state)
L = low level (steady state)
X = irrelevant (any input, including transitions)
↑ = transition from low to high level
a,b,c,d, = the level of steady state input at inputs A,B,C, or D, respectively
Q_{AO}, Q_{BO}, Q_{CO}, Q_{DO} = the level of Q_A, Q_B, Q_C, Q_D, respectively, before the indicated steady state input conditions were established.
Q_{An}, Q_{Bn}, Q_{Cn}, Q_{Dn} = the level of Q_A, Q_B, Q_C, Q_D, respectively before the most recent ↑ transition of the clock

TRUTH TABLE

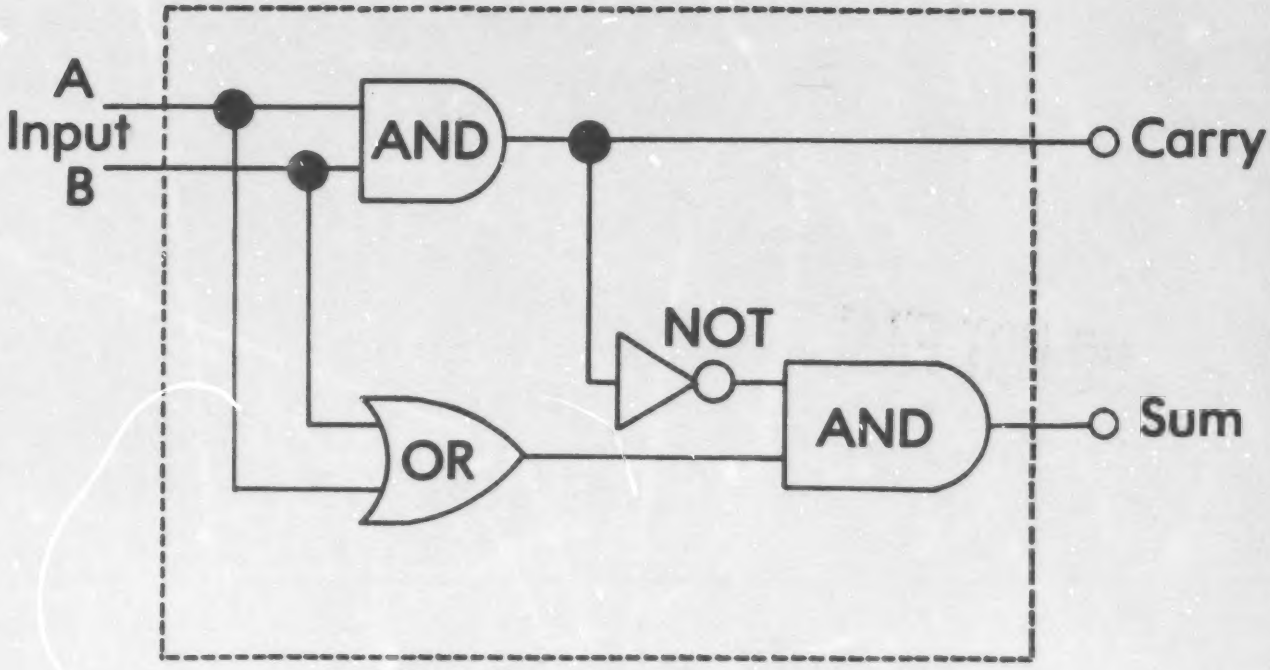


WAVEFORMS

fig. 45

19501

HALF ADDER



BLOCK DIAGRAM

Input		Output	
A	B	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

TRUTH TABLE

SEQUENTIAL LOGIC CIRCUITS XI-C-1(AS)
Key

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. You may use your textbook and class notes as reference. Be sure to check your answers. If you have any questions, ask your instructor.

Combinational 1. Sequential and ____ are the two types of logic circuits.

AND 2. List the three gates used in combinational logic circuits.

OR 3.

NOT 4.

Flip-Flops 5. To construct counters and registers, several ____ can be connected together.

Complementary 6. Flip-flops have two _____ outputs.

Set 7. An RS flip-flop has two inputs called _____ and _____.

Reset 8.

JK 9. The most universal flip-flop is considered to be the _____.

Clock 10. The _____ input controls the action of a flip-flop.

Counter 11. Frequency division can be done using a _____ circuit.

Flip-Flops 12. Several ____ can be wired together to make a counter circuit.

True 13. Counters can be constructed to count up or down. (True/False)

False 14. Counter circuits must be built from flip-flops. (True/False)

7473 15. What is the identification number of a TTL 4 bit binary counter IC?

Shift Register 16. A/an ____ can be used as a memory for a display segment.

Flip-Flops 17. Shift registers can be constructed using _____.

Half-Adder 18. A/an _____ circuit is the basic addition digital circuit.

OR Gate 19. Two half adders and a/an ___ can be used to construct a full adder circuit.

False 20. Very few digital integrated circuits have manufacturer's specification sheets. (True/False)

TEST XI-C-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

Flip-Flops 1. To construct counters and registers, several ___ can be connected together.

RS 2. An ___ flip-flop has two inputs called set and reset.

Complementary 3. Flip-flops have two outputs which are considered ____ with each other.

JK 4. The most universal flip-flop is considered to be the ___.

Counter 5. Frequency division can be done using a ____ circuit.

Clock 6. The ___ input controls the action of a flip-flop.

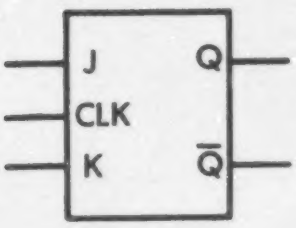
Flip-Flops 7. Several ___ can be wired together to make a counter circuit.

True 8. Counters can be constructed to count up or down. (True/False)

Shift Register 9. A/an ___ can be used as a memory for a display segment.

OR Gate 10. Two half adders and a/an ___ can be used to construct a full adder circuit.

Directions Draw the logic symbol and complete the Truth Table for a JK Flip-Flop.



	INPUTS		OUTPUTS	
CLK	J	K	Q	NOT Q
⊓	0	0	DISABLE	
⊓	0	1	0	1
⊓	1	0	1	0
⊓	1	1	TOGGLE	

INSTRUCTOR'S PLAN
INFORMATIONAL LESSON

XII-A-1(I)

SUBJECT:	Communications Systems
AIM:	Upon successful completion of the lesson, the student will be able to demonstrate an understanding of AM radio, FM radio, television and telephone systems by answering questions.
TEACHING AIDS:	Chalkboard, overhead projector, Transparency Set 19501, figs. 47-51
MATERIALS:	Assignment Sheet - Communications Systems Test Sheet - Communications Systems
TOOLS AND EQUIPMENT:	None
REFERENCES:	Schuler, Electronics-Principles and Applications
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

In this lesson you will become familiar with the block diagrams of some electronic systems. The area of communications is large and can be divided into several sections. Broadcast radio, both AM and FM and television will be included. Telephone systems will also be considered. This and the next unit is intended to give an overview of some of the many areas in which you can specialize.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. AM Radio	1. AM radio 2. Modulation - placing information on the carrier signal
Show Transparency fig. 47	3. Transmitter a. Sound waves to microphone b. Amplified c. Modulation amplifier d. Radio frequency oscillator e. Buffer f. Power amplifier g. Antenna
Show Transparency fig. 48	4. Superheterodyne receiver a. Received by antenna b. Local oscillator c. Received and local signals mixed d. Resultant signal is 455 K Hz intermediate frequency e. Detector - demodulated f. Amplified g. Speaker converts electricity to sound

B. FM Radio

Show Transparency fig. 49

1. Frequency modulation
2. Transmitter
   a. Oscillator produces RF signal
   b. Audio is amplified and sent to the modulator
   c. Modulator causes RF to change frequency controlled by the audio
   d. Frequency is multiplied
   e. Power amplifier feeds antenna

Show Transparency fig. 50

3. FM receiver
   a. Signal received by antenna
   b. Signal mixed with local oscillator signal by mixer
   c. Amplified as intermediate frequency
   d. Limiter limits amplitude changes in signal
   e. Discrimination demodulates signal
   f. Audio amplifier feeds speaker

C. Television

Show Transparency fig. 51

1. Transmitter
   a. Acts as an AM transmitter for video signal
   b. Acts as an FM transmitter for audio signal
   c. Video signal contains picture and sync information
2. Receiver
   a. Both the video and audio are received by the antenna
   b. They are mixed with a local oscillator
   c. They are divided and processed
   d. Video is like an AM receiver
   e. Audio is like an FM receiver

D. Telephone

1. Two communications by "wire"
2. Uses a combination receiver-transmitter
3. Long distance may be carried by wire or by microwave
4. Light fiber is also used

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Communications Systems
2. Check each student's work for accuracy and completeness
3. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

1. Ask oral questions
2. Test Sheet - Communications System
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss the test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Miscellaneous Electronic Systems

AM RADIO TRANSMITTER

SOUND WAVES

MICROPHONE

AUDIO AMPLIFIER

MODULATING SIGNAL AMPLIFIER

ANTENNA

CARRIER ENVELOPE

AMPLITUDE MODULATING CIRCUIT

MODULATED WAVE

CARRIER GENERATION CIRCUIT

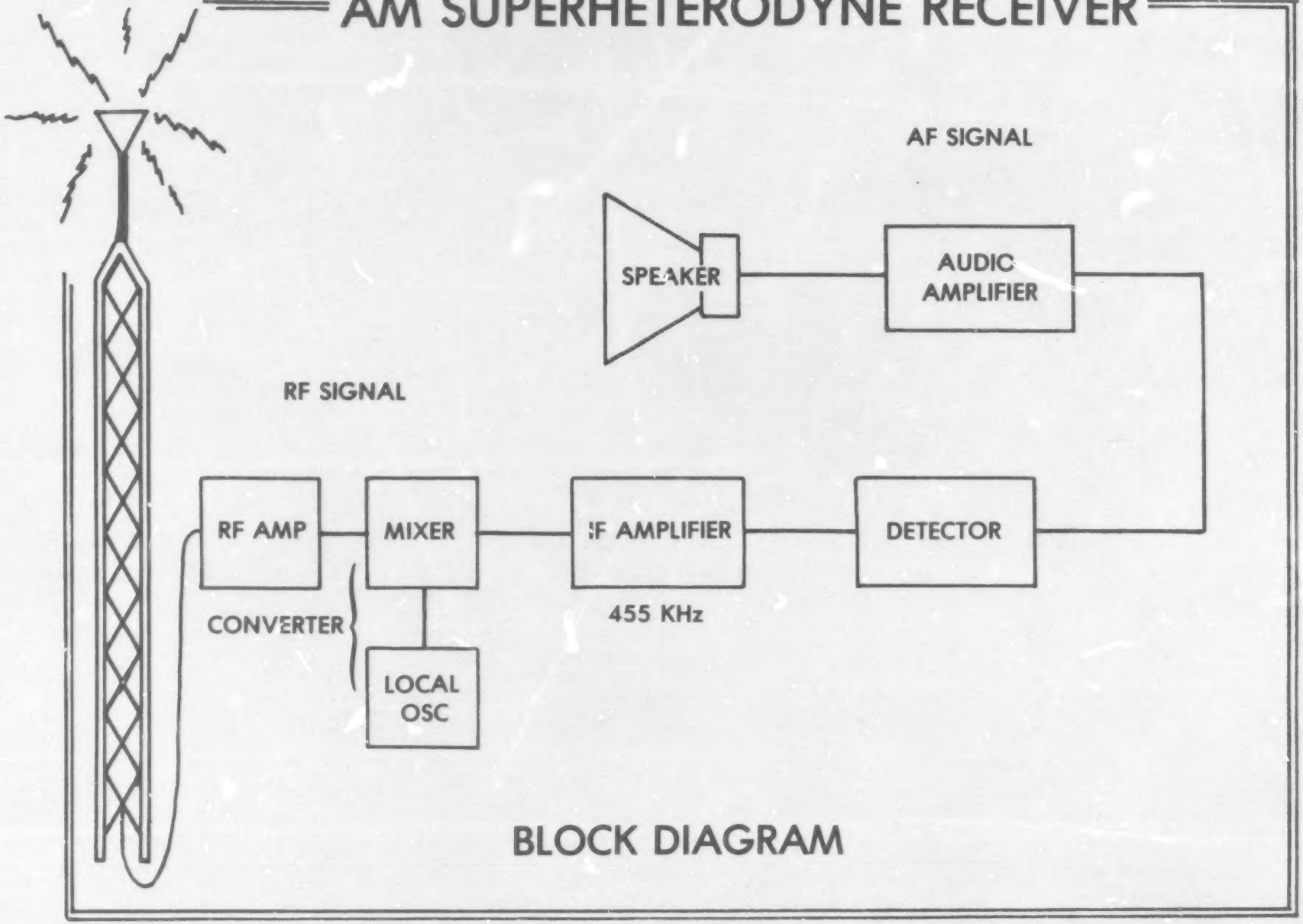
OSCILLATOR

BUFFER

CARRIER SIGNAL

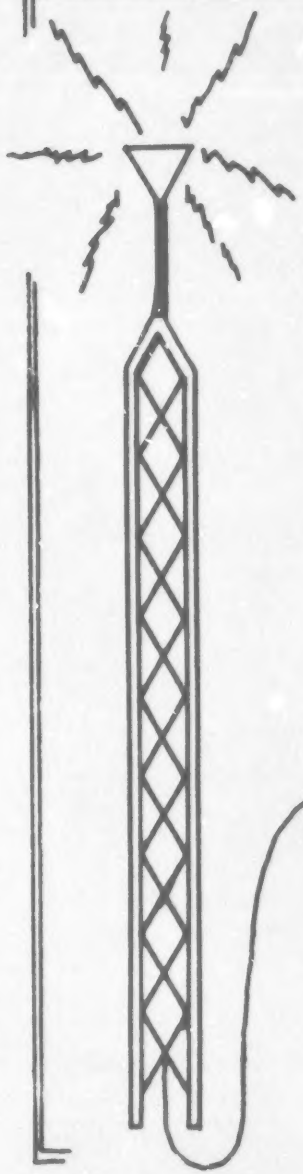
fig. 47

AM SUPERHETERODYNE RECEIVER



BLOCK DIAGRAM

FM TRANSMITTER



MICROPHONE

AUDIO AMPLIFIER

POWER AMPLIFIER

BUFFER AMPLIFIER

MODULATOR

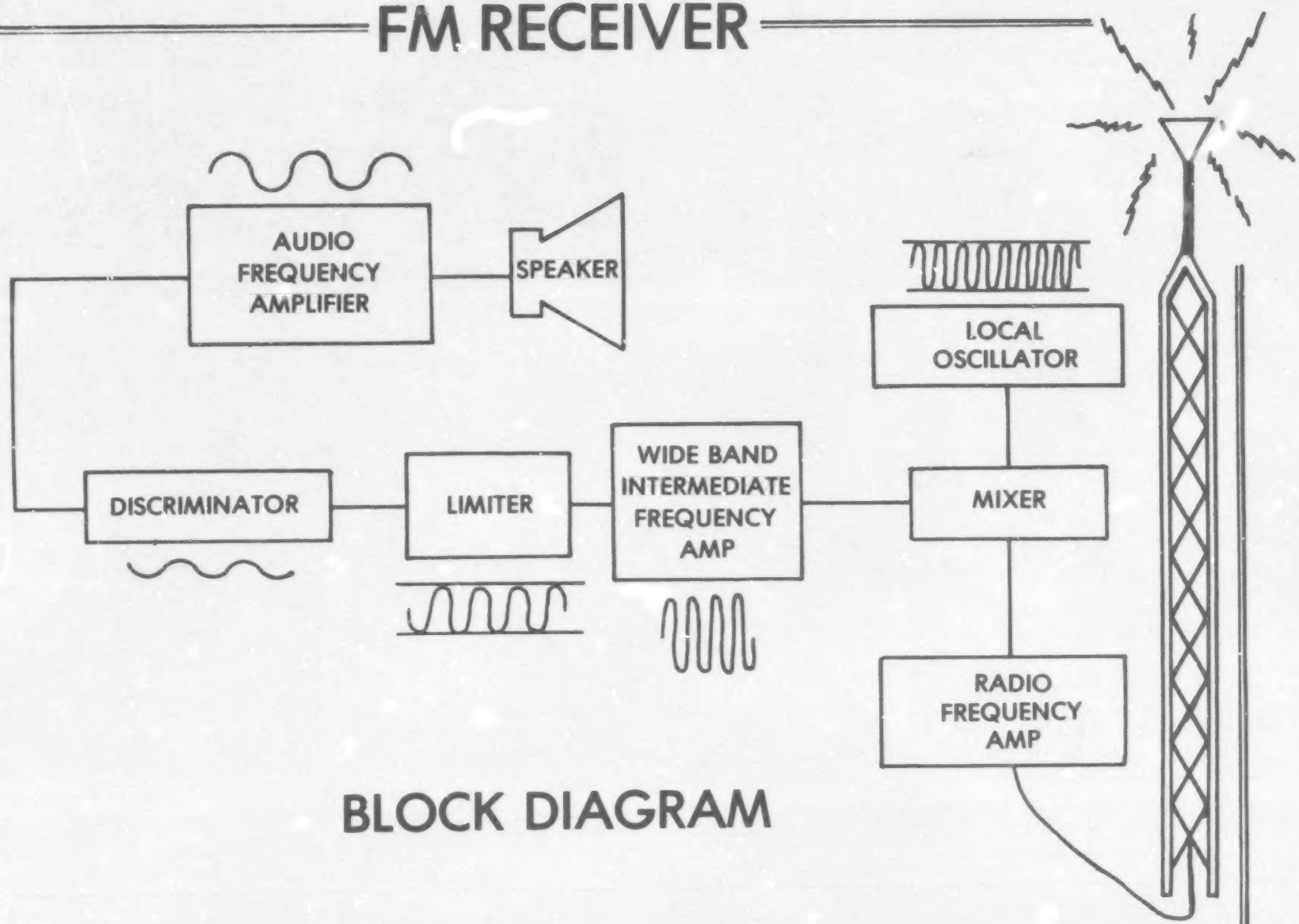
CRYSTAL OSCILLATOR

DRIVER AMPLIFIER

FREQUENCY MULTIPLIERS

BLOCK DIAGRAM

FM RECEIVER



BLOCK DIAGRAM

fig. 50

TELEVISION TRANSMITTER

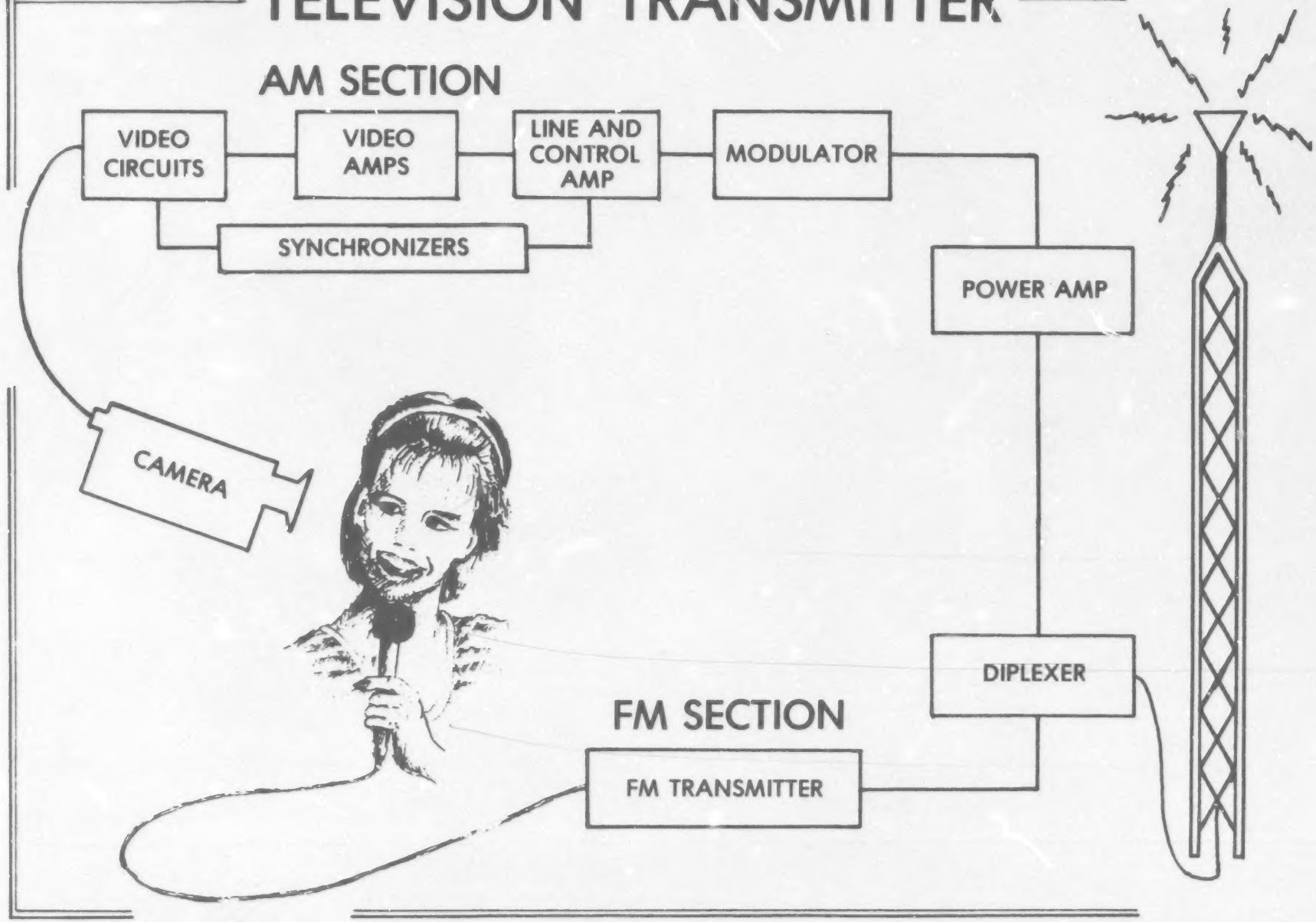


fig. 51

Name_____ Date_____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. You may use your textbook and class notes as reference. Be sure to check your answers. If you have any questions, ask your instructor.

Modulation 1. Placing information on an RF carrier signal is called_____.

Amplitude 2. AM stands for _____ modulation.

Frequency 3. FM stands for _____ modulation.

Buffer 4. The _____ is an amplifier used to separate an oscillator from a power amplifier.

Antenna 5. The _____ is used to radiate or receive the radio frequency from space.

455 K Hz 6. The intermediate frequency of an AM receiver is _____.

Detector 7. Demodulation is done by the _____ circuit in an AM radio.

Discriminator 8. The _____ circuit is used to demodulate an FM radio wave

Local 9. A radio receiver uses a _____ oscillator to produce a wave to mix with the incoming RF carrier.

Fiber Optics 10. Telephone systems use copper wire, microwave and _____ to transmit audio signals.

Directions: On a separate sheet of paper, draw and label the block diagram of an AM radio receiver.

Directions: On a separate sheet of paper, draw and label the block diagram of an FM radio receiver.

TEST

XII-A-1(T)
Key

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

Buffer 1. The ____ is an amplifier used to separate an oscillator from a power amplifier.

Modulation 2. Placing information on an RF carrier signal is called ____.

Discriminator 3. The ____ circuit is used to demodulate an FM radio wave.

Local 4. A radio receiver uses a ____ oscillator to produce a wave to mix with the incoming RF carrier.

Fiber Optics 5. Telephone systems use copper wire, microwave and ____ to transmit audio signals.

Directions: In the space below, draw and label the block diagram of an FM radio receiver.

INSTRUCTOR'S PLAN XII-B-1(I)
INFORMATIONAL LESSON

SUBJECT: Electronic Systems

AIM: Upon successful completion of the lesson, the student will be able to demonstrate an understanding of computer, biomedical and avionics systems by answering questions.

TEACHING AIDS: Chalkboard, overhead projector, Transparency Set 19501, fig. 52

MATERIALS: Assignment Sheet - Electronic Systems
Test Sheet - Electronic Systems

TOOLS AND EQUIPMENT: None

REFERENCES: Gilmore, Charles, Introduction to Microprocessors, McGraw-Hill Gregg Division, New York, 1981
McKinley, James, Aircraft Electricity and Electronics, McGraw-Hill Gregg Division, New York, 1981
Schuler, Charles, Electronics-Principles and Applications

PREREQUISITE EXPERIENCE OF THE LEARNER: All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

In this lesson you will become familiar with the block diagrams of some electronic systems. The areas you will study include computers, biomedical and avionics. This and the last unit are intended to give an overview of some of the many areas in which you can specialize.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Computers Show Transparency fig. 52	1. Central Processing Unit (CPU) a. Main control unit b. Contains ROM c. Contains RAM 2. Data input only a. Keyboard b. ROM memory c. Key pad 3. Data out only a. Monitor b. Printer c. Plotter 4. Data in-out a. Disk drive a. Tape c. Modem (telecommunications) d. Random Access Memory (RAM)

B. Biomedical

1. Systems used for medical purposes
2. Today's systems are based on microprocessors
3. Most have CRT display or numeric readout
4. Systems include:
   a. EKG
   b. Sonogram
   c. Electron microscope
   d. Cat scan
   e. Digital thermometer

C. Avionics

1. Electronics systems associated with aircraft
2. Many of the systems are used in other areas
3. Systems include:
   a. Radio communications
   b. Intercom - international communications
   c. Engine instrumentation
   d. Navigation systems
   e. Radar
   f. Automatic pilot

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Electronic Systems
2. Check each student's work for accuracy and completeness
3. Answer any student questions

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

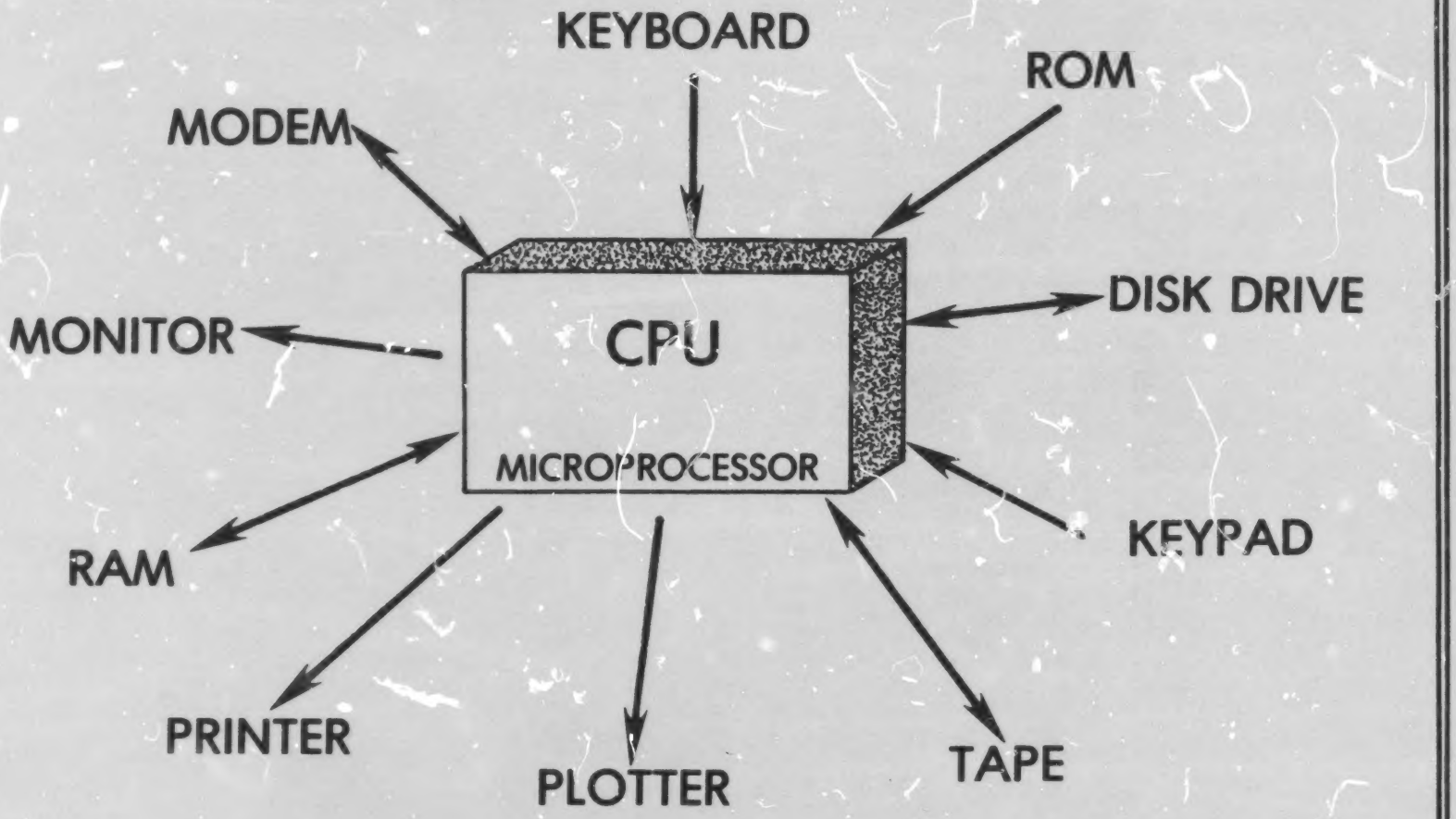
1. Ask oral questions
2. Test Sheet - Electronic Systems
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss the test and answer student questions
2. Review the major topics of the lesson presentation

THE NEXT LESSON IS: Career Opportunities

PERSONAL COMPUTERS



Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. You may use your textbook and class notes as reference. Be sure to check your answers. If you have any questions, ask your instructor.

Microprocessor 1. The CPU or central processing unit contains the ___ or "brain" of the system.

Monitor 2. A temporary visual display is provided by the CRT ____.

Read Only 3. ROM stands for _____ Memory.

Random Access 4. RAM stands for _____ Memory.

Personal 5. A computer that will "stand alone" is considered a ____ computer.

Printer 6. A/an ____ is used for permanent output of alpha-numeric data.

Disk Drive 7. A/an ____ provides faster data access than a tape storage system.

Electron Microscope 8. List three biomedical electronic systems.

Thermometer 9.

EKG 10.

Radar 11. List two aviation electronic systems.

Instrumentation 12.

Directions: On a separate sheet of paper, draw and label the block diagram of a personal type computer.

TEST XII-B-1(f)
Key

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

Keyboard 1. Operator input of alpha-numeric data is through the ____.

Random Access 2. RAM stands for ____ Memory.

Microprocessor 3. The CPU or central processing unit contains the ____ or "brain" of the system.

Printer 4. A/an ____ is used for permanent output of alpha-numeric data.

Disk Drive 5. A/an ____ provides faster data access than a tape storage system.

Directions: Draw and label the block diagram of a personal type computer in the space below.

SUBJECT: Career Opportunities in Electronics

AIM: Upon successfully completing this lesson the student will be able to describe the career options available in the field of electronics and relate the requirements necessary to attain them.

TEACHING AIDS: None

MATERIALS: Assignment Sheet - Career Opportunities
Test Sheet - Career Opportunities

TOOLS AND EQUIPMENT: None

REFERENCES: Gerrish, Howard H., Electricity and Electronics, The Goodheart-Willcox Co., Inc., South Holland, Illinois, 1980
Gerrish, Howard H., Transistor Electronics, The Goodheart-Willcox Co., Inc., South Holland, Illinois, 1981

PREREQUISITE EXPERIENCE OF THE LEARNER: All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

You have now completed a two-year course in vocational electronics. You will soon be graduating from high school and will have to make a decision - a very important decision. You will decide whether to continue your education at a trade school, junior college, university, or in the industry itself. But before you can make an intelligent decision you need to know your options and what is involved in reaching the goal you set for yourself.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Scope of Electronics	1. U.S. Office of Education a. Identifies fifteen career clusters b. Includes over 20,000 types of jobs c. Electronics in all clusters 2. Navigation a. RADAR b. SONAR c. LORAN 3. Medicine 4. Business 5. Construction 6. Sciences 7. Communication 8. Others

B. Growth

1. New discoveries
2. New applications
   a. Robots in industry
   b. Auto ignition system
   c. Home computers
   d. Others

C. Job Categories

1. Goods producing
   a. Sound systems
   b. Radio and television
   c. Electronic components
   d. Security systems
   e. Computers
2. Service producing
   a. Installation
   b. Sales
   c. Maintenance
   d. Repair
3. More workers in service
   a. Maintenance and repair done by technicians
   b. Robots produce robots

D. Career Preparation

1. High School
   a. First step up the ladder
      1.) Self-discipline
      2.) Getting along with others
      3.) Learning to learn
      4.) Basics for electronics
      5.) Science and math
      6.) Entry level vocational training
   b. End of formal education for some
   c. Further training on the job
   d. Larger companies offer opportunities
      1.) Pay for further education
      2.) Offer specialty training
   e. Self-improvement should never stop
      1.) Home study
      2.) Extension courses
2. Technical school
   a. From one to two years
   b. Equipment maintenance
   c. Production work
   d. Lab technician
   e. Associate degree
3. College degree
   a. Four to five years
   b. Bachelor of science degree
   c. Necessary for engineering and science

4. Graduate degree
   a. Becoming more important
   b. Bring top salaries
   c. Master of science
      1.) Specializes in area chosen
      2.) One to two years beyond bachelor's
      3.) Required of most research and development positions
   d. Doctor of philosophy
      1.) Most advanced degree
      2.) One to two years beyond master's
      3.) High level positions
      4.) Scientists, engineers, consultants

E. Going Into Business

1. Most businesses are small
2. May be part-time or hobby
3. Success depends on individual
4. Business sense a "must"
5. More on this in next lesson

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Career Opportunities
2. Monitor and help students on individual basis
3. Check each student's work for completeness and accuracy
4. Invite the school counselor to speak to the group on making a career choice and educational opportunities
5. Invite a military recruiting officer to speak on electronic applications and career opportunities in military service

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

1. Ask oral questions
2. Test Sheet - Career Opportunities
3. 70% correct is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss test and answer student questions
2. Review the major topics of the presentation

THE NEXT LESSON IS: Business Opportunity in Free Enterprise

CAREER OPPORTUNITIES XIII-A-1(AS)
Key

Name _____ Date _____

Directions: Each student will complete this assignment sheet on an individual basis. Read each statement carefully and place the correct answer in the space provided. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

Service 1. The largest number of workers in the field of electronics are those who produce _____.

Growth 2. New applications and discoveries in electronics have caused the field to have a fantastic _____ in recent years.

Ignition 3. Advances in electronics have given us a more efficient auto _____ system.

Reduce 4. Electronic systems have helped ____ the number of people in goods production.

Increase 5. An increase in the number of electronic devices has caused a/an ____ in the number of people in service production.

Entry level 6. Vocational training is designed to prepare a person for _____ employment.

Specialty 7. Large companies often send employees to classes for _____ training.

Associate 8. Students who graduate from a technical school often receive a/an ____ degree.

Doctor 9. The most advanced degree earns the person the title of _____.

Sense 10. One of the most important things a person must have to succeed in business is business _____.

TEST XIII-A-1(T)
Key

Name _____ Date _____

Directions: Read each of the following statements carefully. After deciding whether it is true or false, make a T or F in the blank that corresponds. Check your answers.

F 1. Goods production employs the largest number of workers in industry.

F 2. A saturated market has caused a decline in the electronics industry.

T 3. A better electronic ignition system has helped automobiles to get better gasoline mileage than was possible before.

T 4. The greatest factor in business success or failure is the individual who runs it.

F 5. In order to get a bachelor of science degree, one must attend a technical school.

T 6. A person should learn to learn before going to a technical school or college.

T 7. Science and math are tools used by technicians working in electronics.

T 8. Home study in electronics is a method of improving trade skills.

F 9. After attaining the doctorate, one should consider oneself at the top of the ladder and stop studying.

T 10. Starting out as a hobby has led to many successful businesses.

SUBJECT: Business Opportunity in Free Enterprise

AIM: Upon successfully completing this lesson the student will be able to describe the role of small business in our free enterprise system and relate the advantages of living in the United States of America.

TEACHING AIDS: None

MATERIALS: Assignment Sheet - Business Opportunity
Test Sheet - Essay Test

TOOLS AND EQUIPMENT: None

REFERENCES: Woodburn, Clint H., Enterpreneurship - The Art of Business Ownership, Vocational Instructional Services, Texas A&M University, F.E. Box 182, College Station, TX, Unit I

PREREQUISITE EXPERIENCE OF THE LEARNER: All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

Since most of us have grown up in the free enterprise system, we may sometimes forget to appreciate its freedoms and advantages. Perhaps we can best demonstrate our own by comparing it to some other economic systems. We will then understand why the idea of being financially secure and being one's own boss is called the "American dream" instead of the "Russian dream".

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Socialist System	1. Government ownership of economy a. Land, forests, minerals, etc. b. Farms, sawmills, mines, factories c. Owns banks - financial system d. Transportation systems e. Communication systems 1.) Radio and TV stations 2.) Newspapers 2. "Committees" make decisions a. What will be produced b. Quality and quantity of product c. Pricing 3. People work for government

B. A Taste of Freedom

1. Few are allowed garden
   a. Small plots next to housing
   b. Must have government approval
   c. Allowed to sell surplus
2. These are very productive
   a. More productive than state farms
   b. Money motive
   c. Reduces food imports from "capitalists"

C. Free Enterprise System

1. Bill of Rights guarantees
   a. Right to own property
   b. Individuals own almost everything
   c. Government ownership limited
      1.) National forests
      2.) National seashores
      3.) Desert land
   d. What we do for a living
   e. Business ownership
      1.) As individuals
      2.) In partnership
      3.) Part owner - stocks
2. Market controls as consumers
   a. What will be produced - example: big cars vs. small cars
   b. Quality and quantity - inferior goods do not sell - production stops
   c. Pricing of goods and services
      1.) Over supply causes "buyer's market"
      2.) Short supply causes "seller's market"
          example: gasoline shortage of '70's

D. Competition - The Key

1. Business competes for market
   a. Make product more desirable
   b. Better quality at lower price
   c. Advertising informs public
2. Henry Ford - Entrepreneur
   a. Perfected assembly line technique
   b. Built reliable car for low price
   c. Expanded market to include average income people
   d. Shared company profits with workers
   e. Model "T" was great success

E. Business Opportunity

1. 95% of U.S. business is small
2. Employs over half the work force
3. Does 40% of business volume
4. Population expansion
   a. Uneven death rate/birth ratio
   b. Immigrants
   c. Combination means more people
5. Electronics still in infant stage
6. Opportunity is there

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Business Opportunity
2. Monitor and help students on individual basis
3. Have students read their Assignment Sheet paragraphs aloud and discuss
4. Invite a representative of your local Chamber of Commerce to make a presentation to the class

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

1. Ask oral questions
2. Test Sheet - Essay Test
3. Passing grade on essay required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss test and answer student
2. Review the main topics of the lesson

THE NEXT LESSON IS: Business - What You Need To Know

BUSINESS OPPORTUNITY

XIII-B-1(AS)
Key

Name _____ Date _____

Directions: Using your class notes, textbook, and any other references write a paragraph concerning the topics listed below. Check your work for sentence structure, spelling, and punctuation. Use your own words.

1. Russian economic system

2. Russian collective farms and garden plots

3. Bill of Rights and business freedom

4. Consumer control of production

5. Henry Ford's ideas

6. Small business in the U.S.A.

ESSAY TEST XII-B-1(T)
Key

Name _____ Date _____

Directions: Write a one-page essay comparing the free enterprise system with the socialistic economic system. Outline your essay on a separate page before beginning. You may use reference materials, but keep direct quotes to a minimum.

INSTRUCTOR'S PLAN XIII-C-1(I)
INFORMATIONAL LESSON

SUBJECT:	Business - What You Need To Know
AIM:	Upon successfully completing this lesson the student will be able to relate the areas that should be studied in depth before risking a business venture.
TEACHING AIDS:	None
MATERIALS:	Assignment Sheet - Business Test Sheet - Business
TOOLS AND EQUIPMENT:	None
REFERENCES:	Woodburn, Clint H., Entrepreneurship - The Art of Business Ownership
PREREQUISITE EXPERIENCE OF THE LEARNER:	All prior lessons

I. PREPARATION (OF THE LEARNER - MOTIVATION)

It is hoped that this lesson will not only help you to make up your mind someday about whether or not to go into business, but that it will also help those who do to avoid the pitfalls which often cause would-be entrepreneurs to lose their life savings in ill-fated business ventures.

Timing and luck are involved somewhat, but in order to "stack the odds" in your favor so that luck will play a smaller part, you should study and learn as much as possible about doing business in our free enterprise system. Here are some of the things you need to know.

II. PRESENTATION (OF THE INFORMATION)

INSTRUCTIONAL TOPICS TEACHING POINTS	THINGS FOR STUDENTS TO DO THINGS FOR INSTRUCTOR TO DO OR SAY
A. Know Yourself	1. Most important success factor is owner 2. Owners' lack of ability and experience cause 90% of failures 3. Are you highly motivated a. Can you stick to it b. Losing interest causes neglect 4. Do you get along with others 5. Are you fair and honest 6. Can you wear many "hats"
B. Business Location	1. Home or garage possible 2. Choice of town or community a. Your own satisfaction b. Economic conditions c. Need for your services

3. Site selection
   a. Zoning laws
   b. Traffic and parking
   c. Neighboring businesses
   d. Competition
4. Building selection
   a. Customer appeal
   b. Sufficient utilities
   c. Size and space
   d. Physical condition
   e. Interior design

C. Leasing Contract

1. Consult an attorney
   a. Understand every item
   b. Look for hidden clauses
   c. Avoid a lawsuit
2. Compared to marriage

D. Franchise

1. Is a method of distribution
2. Small business part of large business
3. Gives right to market product or service
4. Cost of franchise
5. Advantages
   a. Business experience of franchisor
   b. Less capital to start up
   c. Better credit standing
   d. Customer pulling power
   e. Higher profit margin
   f. National advertising
   g. Prepared advertising kits
6. Disadvantages
   a. Sacrifice independence
   b. Others make decisions
   c. Unprofitable items
   d. Paying into promotion funds
   e. Paying percentage of profit
   f. Parent company dictates
7. Ask questions and consult a lawyer

E. Start-Up Expenses and Reserves

1. Poor money management biggest cause of failure
2. New business takes time to show profit
   a. Weeks, months, or longer
   b. Financial reserves necessary
3. Cost-of-living multiplied by three
   a. Monthly payments
   b. Household expenses
   c. Family expenses
   d. Taxes

4. Business start-up costs
   a. Building rent or deposit
   b. Tools and equipment
   c. Starting invertory
   d. Deposits
   e. Legal fees
   f. Permits and licenses
   g. Advertising
   h. Operating cash
   i. Accounts receivable
5. Monthly business expense x 3
   a. Your salary or cost-of-living
   b. Rent and advertising
   c. Materials and delivery
   d. Telephone and other utilities
   e. Insurance
   f. Taxes and Social Security
   g. Interest
   h. Maintenance and legal fees
   i. Salaries and wages
   j. Miscellaneous
6. Adding all gives cost of going into business

F. Sources Of Capital

1. Yourself - equity capital
   a. Personal savings
   b. Property you own
   c. Life insurance policies
2. Commercial bank
3. Savings and Loans
4. Small Business Administration
5. Open accounts - trade credit
6. Trust companies
7. Commercial finance companies

G. Loan Proposal

1. Is a business plan requesting loan
   a. Start with summary
   b. Profile of self and key personnel
   c. Describe the business
   d. Growth projections
   e. Financial statements
   f. Exact sum needed and use intended
   g. Repayment plan
2. Points to remember
   a. Never make untrue claims
   b. Never hide anything
   c. Mutual trust very important
   d. Banker can advise

H.	Business Organization	1. Sole owner a. Advantages b. Disadvantages 2. Partnership a. Advantages b. Disadvantages 3. Corporation a. Advantages b. Disadvantages
I.	Marketing	1. Advertising a. Media available b. Number reached and cost c. Increased volume 2. Public relations promotion 3. Merchandising a. Front of building b. Inside of building
J.	Business Language	1. Invoice terms a. Net, prox, discount b. Date of invoice, E.O.M. c. Dated as of, C.O.D. 2. Selling price formula 3. Service all pricing 4. Selling on credit 5. Not check hazard
K.	Business Regulations	1. Federal regulations 2. State regulations a. Laws b. Licenses or permits 3. County and city a. Zoning b. Ordinances
L.	Taxes	1. Get an account 2. "Employers Tax Handbook"
M.	Insurance	1. Kinds of companies a. Stock b. Mutual 2. Insurance terms a. Premium b. Dividend c. Policy d. Insurable interest 3. Many kinds available 4. Liability
N.	Record Keeping	1. Very important for business 2. Bank records 3. Bookkeeping 4. Ledgers 5. Cash book

6. Profit/loss statement
7. Balance sheet
8. Cash flow projection

O. Personnel Management

1. Finding employees
2. Hiring employees
   a. Job applications
   b. Interviewing
   c. Checking references
3. Training employees
4. Personnel relations
   a. Job satisfaction
   b. Compensation
   c. Fringe benefits

III. APPLICATION (DRILL, ILLUSTRATIONS, ANALOGIES, ORAL QUESTIONS, OR ASSIGNMENTS, MAKING INVESTIGATIONS OR EXPERIMENTS, NOTE TAKING, MAKING SKETCHES, PARTICIPATING IN DISCUSSION.)

1. Assignment Sheet - Business
2. Monitor and help students on individual basis
3. Check each student's work for accuracy and completeness
4. Invite a successful entrepreneur to speak to the class
5. Invite a member of SCORE (Service Corps of Retired Executives) to speak to the class

IV. VERIFICATION AND/OR EVALUATION (FINAL CHECK ON STUDENT'S COMPREHENSION OF MATERIALS PRESENTED.)

1. Ask oral questions
2. Test Sheet - Business
3. A passing grade is required for satisfactory completion of the lesson

V. SUMMARY (GIVE A BRIEF ACCOUNT OF EACH TOPIC REEMPHASIZING THE IMPORTANT POINTS. THIS SUMMARY MAY BE GIVEN AT ANY PLACE IN THE LESSON THE TEACHER FEELS WILL BE PROFITABLE TO THE STUDENT.)

1. Discuss test and answer student questions. Have students read answers aloud and discuss
2. Review the major topics of the presentation

For a more thorough understanding of what is involved in going into business, we would like to suggest the self contained sutdent workbook, Entrepreneurship - The Art of Business Ownership. It is available from the address in the front of this publication at a very nominal cost.

BUSINESS XIII-C-1(AS)
Key

Name _____ Date _____

Directions: Each student will complete this assignment sheet on an individual basis. Read each statement carefully and place the correct answer in the space provided. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

Owner 1. What is the most important element in succeeding in business?

Sole owner 2. Name three types of business organization.

Partnership 3.

Corporation 4.

Loan 5. A self profile and a financial statement are used in a _____ proposal.

Trust 6. It can be said that mutual _____ is important between a borrower and a lender.

Marketing 7. Taken together, advertising and merchandising are termed ____.

Invoice 8. Prox, E.O.M., and Net are _____ terms.

Insurance 9. Premium and dividend are _____ terms.

Zoning 10. Cities regulate business locations with _____ laws.

Interest 11. If you do not own a building but can buy insurance on it because of your business you have an insurable _____.

Stock 12. Name two kinds of insurance companies mentioned in this lesson.

Mutual 13.

Wages 14. Compensation is another word for salary or _____.

Cash flow 15. Estimating the amount of money coming in and going out over a given period is a _____ projection.

References 16. One should never hire an employee until ___ are contacted.

Fringe benefits 17. Paid vacations and holidays are examples of _____.

Liability 18. The insurance a business buys to protect itself from lawsuit is _____.

Public relations 19. If a business sponsors a little league team it is promoting ____.

Corporation 20. A business that has the right to do business as an individual is a _____.

Volume 21. Advertising is used by business to increase _____.

90 22. Inexperience and lack of ability causes _____% of business failures.

Motivated 23. If you always do your best and stick to a job until it is done you are highly _____.

Marriage 24. A leasing contract can be compared to a _____.

Attorney 25. Before signing a leasing contract one should consult a/an _____.

TEST XIII-C-1(T)
Key

Directions: Using your class notes and other references write a paragraph concerning the topics listed below. Check your work for sentence structure, spelling, and punctuation. Use your own words.

1. A business owner can be compared to the captain of a ship. Explain this.

2. Why is the business location so very important?

3. Explain why you would or would not consider going into a franchise agreement.

4. Explain the phrase, "Small business is big business."

5. Explain the hows and whys of writing a loan proposal.

6. Describe your marketing strategies if you were starting a business.

7. Describe how and why business is regulated.

BIBLIOGRAPHY

Malcolm, Douglas, How to Build Electronic Projects, McGraw-Hill, New York, NY, 1980

Woodburn, Clint H., Development of Professional Attitudes, Vocational Instructional Services, Texas A&M University, F.E. Box 182, College Station, TX 77843 1977

Woodburn, Clint H., Entrepreneurship - The Art of Business Ownership, Student Workbook, Vocational Instructional Services, Texas A&M University, F.E. Box 182, College Station, TX 77843, 1983

Andrews, Alan, Electronics Math, Howard Sams Co., Indianapolis, IN, 1975

Fowler, Richard J., Electricity - Theory and Applications, McGraw-Hill, New York, NY, 1979

Grob, Bernard, Basic Electronics, 4th Ed., McGraw-Hill, New York, NY, 1977

Schuler, Charles, Electronics-Principles and Applications, McGraw-Hill, Gregg Division, New York, NY 1979

DeVito, Michael J., Introduction to Electricity and Electronics, 2nd Ed., Buck Engineering Co. Inc., Farmingdale, NY, 1971

Tokheim, Roger, Digital Electronics, McGraw-Hill, Gregg Division, New York, NY 1979

Tokheim, Roger, Activities Manual for Digital Electronics, McGraw-Hill, Gregg Division, New York, NY 1979

Gilmore, Charles, Introduction to Microprocessors, McGraw-Hill, Gregg Division, New York, NY 1981

McKinley, James, Aircraft Electricity and Electronics, McGraw-Hill, Gregg Division, New York, NY 1981

Transparency Set 19501, Vocational Instructional Services, Texas A&M University, F.E. Box 182, College Station, TX 77843

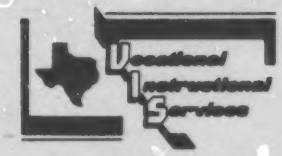
TX84/1330

SECOND YEAR
STUDENT WORKBOOK
FOR
VOCATIONAL ELECTRONICS

Written by Chuck Solanik

Illustrated by Mike Harrison

Published by
VOCATIONAL INSTRUCTIONAL SERVICES
VOCATIONAL INDUSTRIAL EDUCATION
TEXAS A&M UNIVERSITY
F. E. BOX 182, COLLEGE STATION, TEXAS 77843



In Cooperation With
VOCATIONAL INDUSTRIAL EDUCATION
OCCUPATIONAL EDUCATION AND TECHNOLOGY
TEXAS EDUCATION AGENCY

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

All Rights Reserved

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Page

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

ACKNOWLEDGEMENT

A sincere note of gratitude to Mr. Chuck Solanik, electronics instructor at John Jay High School in San Antonio, who found time in his busy schedule to compile the materials and develop this Vocational Electronics Course of Study.

INTRODUCTION

This Student Workbook II is intended for use with Vocational Electronics Course of Study written by Mr. Chuck Solanik and published by Vocational Instructional Services, Texas A&M University.

When using this workbook be sure to follow directions of your instructor. This is also especially important when working experiments in the laboratory. If you are not sure about safety procedures, STOP where you are and ask your instructor.

TABLE OF CONTENTS

VII-A-	Skill Development	1
	Technical Skill Development Assignment Sheet	1
	Test - Project Rating Sheet	59
-B-	Finding and Applying for a Job Information Sheet	2
	Sample Letter of Inquiry	5
	Personal Data Sheet Assignment Sheet	6
	Job Application Assignment Sheet	7
	Test	61
-C-	Job Interview Preparation Information Sheet	8
	Questions Asked During Interview	10
	Crossword Puzzle	11
-D-	Employment Responsibility Information Sheet	12
	Employer-Employee Responsibility Assignment Sheet	16
	Test	63
VIII-A-	AC Mathematics	19
	AC Mathematics Assignment Sheet	19
	Test	65
-B-	R-L-C Circuits Assignment Sheet	21
	Test	67
IX-A-	Semiconductors Assignment Sheet	23
	Test	69
-B-	Diodes Assignment Sheet	25
	Diode Testing Task Sheet	27
	Test	71
-C-	Transistors Assignment Sheet	29
	Transistor Testing Task Sheet	31
	Test	73
-D-	Special Semiconductors Assignment Sheet	33
	Test	75
X-A-	Power Supply Circuits Assignment Sheet	35
	Test	77
-B-	Amplifier Circuits Assignment Sheet	37
	Test	79
-C-	Oscillator Circuits Assignment Sheet	39
	Test	81
XI-A-	Digital Introduction Assignment Sheet	41
	Test	83
-B-	Digital Logic Gates Assignment Sheet	43
	Test	85
-C-	Sequential Logic Circuits Assignment Sheet	45
	Test	87
XII-A-	Communications Systems Assignment Sheet	47
	Test	89
-B-	Electronic Systems Assignment Sheet	49
	Test	91

XIII-A- Career Opportunities Assignment Sheet---------- 51
Test---------- 93
-B- Business Opportunity Assignment Sheet---------- 53
Essay Test---------- 95
-C- Business Assignment Sheet---------- 55
Test---------- 97

Name _____ Date _____

Directions: After selecting a project, make an estimate of the total cost using current component catalogs. Draw the schematic diagram of the project on a separate sheet. When you have completed this, discuss the project with your instructor. The instructor must approve the project before you begin work.

Project: _____ Instructor's Approval: _____

Description: _____

_____

Const. Method: _____ Total Estimated Cost: _____

Parts List:	Cost:	Parts List:	Cost:

The primary purpose behind education, and vocational education in particular, is to equip people with skills and knowledge so that they may lead happy, productive lives. Since we live in a highly mobile society and may change jobs several times before "settling down", our education is incomplete if we have no knowledge concerning methods for locating employment.

Many surveys and studies have been conducted to determine better ways of finding a job. Some of these methods are discussed below. The job seeker should keep in mind that good judgement should be used with each of them.

Suggestions from relatives and friends - About 50% of the jobs obtained have been secured through helpful tips from some relative or friend. Many times positions are filled by this method before the job opening is advertised or reported to the employment agency.

It is important to remember that job seekers should neither expect nor use influential aid from friends or relatives that would misrepresent their willingness or capabilities. Nothing is accomplished for either the employer or the employee when a relative or friend helps get a job for someone who is neither interested in the job nor qualified for the position.

Personal Contacts - This is the second most effective method for locating employment. It involves walking to various employer's offices, knocking on doors, and sitting in waiting rooms. It is important to remember when making personal contacts that skill in "selling yourself" is necessary for success. People are hired only after they have convinced the employer that they would be an asset to the company.

Newspapers - When answering a newspaper ad, either by letter, telephone, or in person, the job seeker should remember that the sooner the contact is made the better the chance of getting the job. Another way to use the newspaper to find a job is to place a personal ad in the "situation wanted" section. When using this method, job seekers should make sure they can be easily contacted by prospective employers.

Letter of Inquiry - The letter of inquiry or letter of application is an excellent means of locating employment in other towns or areas. It should contain all the necessary information relating to personal data, education, experience background, etc. It should also clearly state the position being applied for and request a formal application and an interview. Many employers prefer that letters of this nature be handwritten because they feel they are able to interpret many of an individual's characteristics from the handwriting. For this reason, a letter of inquiry should be very carefully worded with special attention to the punctuation, spelling, and neatness.

Employment Agencies - The term "employment agency" is not restricted to the state

employment service, but includes the local school counseling service, community employment organizations, and private employment companies. These agencies usually maintain trained placement personnel who may be of assistance to the job seeker.

Letter of Application - After job seekers have done the groundwork of securing information on job leads and have learned as much as possible about the company, they are then ready to contact the employer. This may be done by personal contact or by writing a letter of application. In many instances, even after a personal contact is made, the employer will request a letter of application. This gives the employer a handwriting sample and is a clue to the applicant's ability to express ideas in sentence form. Also, there are times when a written letter of application is the only way of getting a job interview.

A letter of application should be written in the following situations:

1. When applying for a position out-of-town.
2. When seeking an interview with an employer who is a family friend.
3. When answering a newspaper ad that requests one.
4. When an employer requests that a letter of application be written.

A letter of application is a means of selling oneself to the employer. It will, therefore, need to make a good first impression. The following suggestions will help in writing a letter of application that will get attention.

1. If at all possible, the letter should be written to a specific person, not merely to the firm.
2. Be sure that all names are spelled correctly. If necessary call by telephone to verify spelling of names.
3. Be brief and original. Come to the point quickly.
   a. Start the letter by stating exactly what position or type of position is being sought.
   b. Do not go into ability or background. Enclose an outline of the details or leave them for the interview which may follow later.
4. Type the letter or write neatly. Never use pencil. Use short paragraphs and limit the letter to one page.
5. Use a good quality of standard size paper.
   a. Write only on one side and avoid erasures.
   b. Do not use letterhead stationery unless it is your own.
6. Use correct spelling and punctuation.
7. Have an effective closing paragraph.
   a. Be sure to ask for an interview at the employer's convenience.
   b. Use business-like closing.

Personal Data Sheet - A well written letter of application may be all that is necessary to get a job interview. However, it is sometimes advantageous to include additional

information in a personal data sheet. This is an accepted way of presenting information that is not in the letter of application. The personal data sheet may include facts concerning physical stature and general health, courses taken in school, work experience, skills, hobbies, and references. It may be better to list these details on a data sheet instead of including them in the letter of application.

Application Forms - If the job is applied for in person instead of by mail the usual procedure is to fill out an application form prior to the interview. A copy of the personal inventory or data sheet is very helpful in completing the application form. A person should also have three references with correct addresses and telephone numbers. These people should be contacted in advance to get their permission to be used as references.

Written application forms will vary from business to business, but the information on a personal inventory form is always basic. One should also remember that no matter what type of form is used a great deal of information can be gained by the employer concerning the applicant's neatness and ability to complete the form.

The following suggestions may be helpful in filling out application forms.

1. Read the instructions carefully and follow them exactly. The form will usually indicate a preference for pen or pencil and whether writing or printing is to be used.

2. Always write or print neatly and legibly and be careful of messy erasures and soiled appearance of the completed form.

3. Do not omit any questions which apply and if there is no answer, write "none" or "N.A." for "not applicable" in the blank provided for the answer.

4. Read each question carefully and understand it completely before beginning to write.

5. Have an information sheet with names and addresses of personal references, employment history, education background, health record, and other pertinent information.

P.O. Box 000
Townville, Texas 77807

September 21, 1985

Mr. Bill Bartley, Manager
Big Town Electronics
310 Main Street
Townville, Texas 77807

Dear Mr. Bartley:

Mr. Smith, industrial cooperative training teacher-coordinator at Townville High School, has informed me of a vacancy in the computer repair department of your firm. I would like to submit my name to be considered for the position.

At present I am a senior enrolled in the industrial cooperative training program at Townville High. I am therefore available for employment after 1:00 p.m. on school days and for the entire day on Saturdays.

I have completed two years of pre-employment lab training in vocational electronics, and last summer I worked for Downtown Computer Center. I am a member of the Vocational Industrial Clubs of America, and this past spring placed second in the vocational electronics skill contest at the District Meet.

I am interested in a career in the electronics industry and recognize the value of being associated with a firm of your reputation. I would appreciate a personal interview with you at your earliest convenience so you may become better acquainted with my qualifications. I am available for an interview after 1:00 p.m. on school days and any time on Saturdays.

I may be contacted at the above address or through Mr. Smith at the high school. I am looking forward to your reply.

Sincerely,

John McMahan

PERSONAL DATA SHEET VII-B-1(AS)

Personal

Name _____
Address _____ Phone _____
Age _____ Height _____ Weight _____
Health _____
_____

Education

High School _____
Subjects _____
_____

Organizations
Leadership Activities

Work Experience

Skills

Hobbies

References

APPLICATION VII-B-1(AS)

Name _____ Social Security No. _____

Present Address _____ Home Phone No. _____

Date of Birth: Month _____ Day _____ Year _____ Age _____

Do you live with parents? _____ Relatives? _____

What kind of vocational courses have you taken? _____

_____

How many years of vocational coursework have you completed? _____

Who referred you for occupational experience? _____

List hobbies or recreational activities you enjoy: _____

_____

What sports do you enjoy? _____

In what extracurricular activities do you participate? _____

_____

(Education)

	School	City	Dates From	Dates To	Graduated
Elementary					
High School					
Other					

List each machine you can operate: _____

_____

Have you learned a trade? _____ Kind: _____

How soon would you be available for work? _____

(Health)

Name of family physician _____ Your Height _____ Weight _____

What illnesses or operations have you had in recent years? _____

_____

Were you ever injured while working? _____ How many times? _____

Are you physically handicapped? _____ Describe: _____

Person to notify in case of emergency: _____

Relationship _____ Address _____ Phone _____

Signature _____ Date _____

The twenty to thirty minutes spent in an interview can be some of the most important time an applicant will spend in procuring a job. For no matter how well letters of application and forms are filled out, the true test is in the employer's face-to-face evaluation. The applicant should, therefore, study and make detailed preparations for this final exam - the interview.

The applicant should remember that the first impression is generally a long lasting one. Also, the person being interviewed must make a favorable impression on the employer the first time, because usually there is only one personal interview. The success or failure of the applicant in securing the position depends to a large extent on the impression made on the employer.

The purpose of the interview is to permit the employer to learn some things about the applicant - attitude toward people and work, education and work experience, future career plans, and goals in life. The reason employers are interested in these things is the desire to get the best possible person for the position. Just as we always try to buy the best for our money, employers like to "shop around" for individuals who will do the best job possible.

INTERVIEW PROCEDURE

Most job interviews are conducted in the following manner. The receptionist greets the applicant in an outer office. After the necessary forms and papers are filled out, the receptionist then takes them in to the interviewer. The reason we mention this seemingly minor detail is because it is usually very important. The opinion of the receptionist concerning the applicant carries a lot of weight with the boss. In other words, be nice to the receptionist.

During a job interview an employer usually guides the conversation by asking significant questions. A friendly atmosphere is created and the applicant responds by carrying on most of the conversation. While the applicant talks the interviewer will be searching for clues to the individual's personal qualities: enthusiasm, initiative, dependability, moral character, ability to get along with others, and capacity to do the work.

PERSONAL INVENTORY

The job applicant is, in effect, attempting to do a selling job - the services he or she can perform for the company. Anyone who has had the opportunity of watching a good salesperson work knows the salesperson has thorough knowledge about the product being sold. Like the successful salesperson, all job applicants should be well acquainted with the products being sold - themselves. In order to gain more thorough knowledge about themselves, job seekers should prepare written personal inven-

tories. This is not done to be presented to the employer, but for the applicant's own study and benefit.

KNOW THE COMPANY

Prior to the interviewer, an applicant should gather as much information about the firm as possible. The location of plants, kinds of products sold or manufactured, types of services rendered, growth trends, and employment opportunities available are some facts that should be helpful during an interview. This information is important regardless of the size of the firm, and a good way to get it is by talking to one of our more of the employees.

THE INTERVIEW

There are some very basic considerations to remember on the day of the interview that will help to make a good impression.

Personal Appearance - The applicant should be neatly dressed but not overdressed for the job being sought. For many jobs, especially those which require the worker to deal with the public, wearing a coat and tie would be fitting. For others, such as a job on a construction site, a coat and tie might be considered overdressed. In any case, the applicant should wear clean, well pressed clothes and shined shoes. The hair should be combed, fingernails cleaned, teeth brushed, and boys should have a shave. The applicant should not smoke unless invited to do so by the prospective employer. One should, at all times, consider oneself a guest in the employer's office and should act accordingly.

Promptness - A good salesperson never keeps the customer waiting and this is a good example for the job applicant. A person who is tardy for a job interview creates a very unfavorable impression.

Exclusion - The applicant should always go alone for the interview. Most employers resent persons applying in groups or pairs, and in many instances the friend or companion has been hired instead of the person who was applying for the job.

IN CONCLUSION

The job applicant should not be too disappointed if unable to make the desired impression on the first try. Make an appointment for an interview with another firm and learn from the mistakes made during the first one. After a "practice trial" the applicant should become more familiar with the procedure and be better able to convey the self-confidence, poise, and maturity that all employers are looking for in employees. After all, even the best salesperson does not make a sale every time.

The following list of questions may help you to better prepare yourself for the interview.

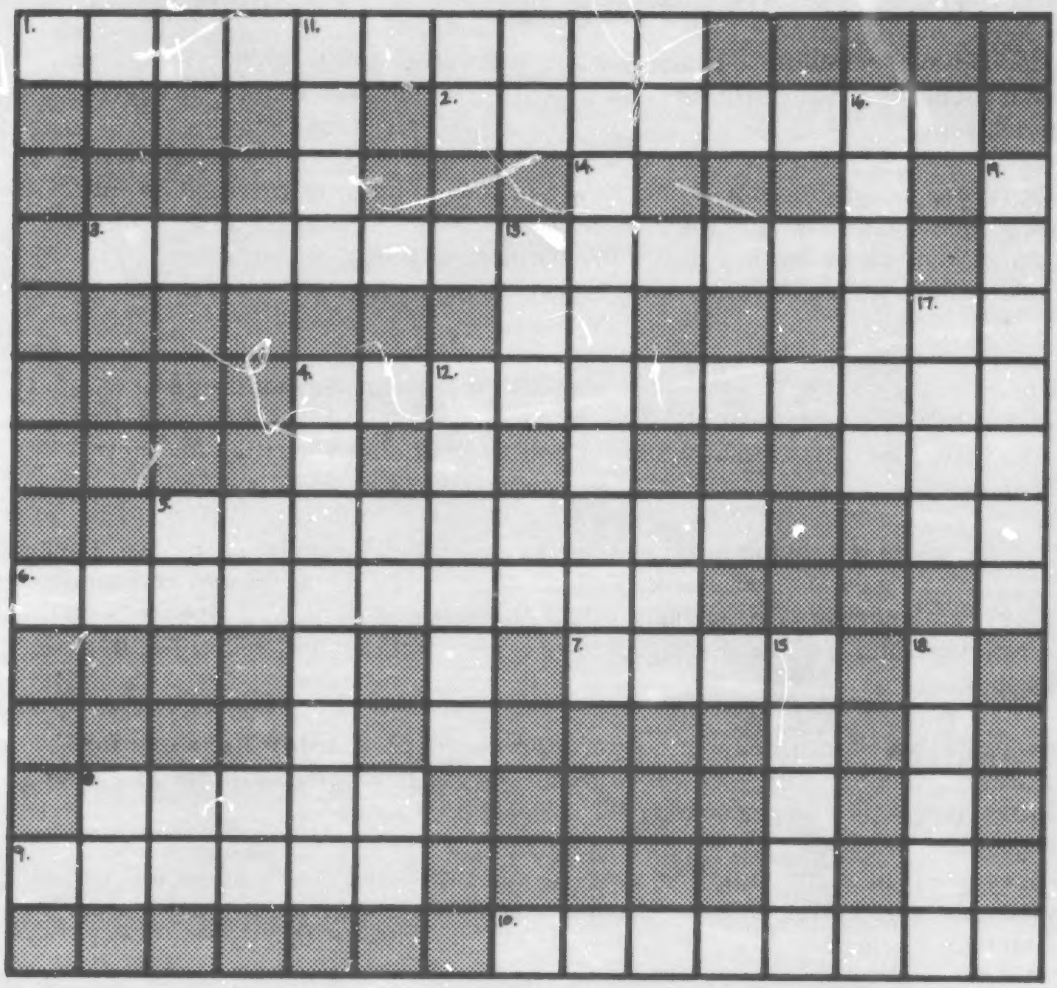
1. Why would you like to work for our company?
2. Are you seeking temporary or permanent employment?
3. In what type of work are you most interested?
4. Do you prefer working by yourself or would you prefer to work with others?
5. What qualifications or training do you have for this job?
6. Where did you rank in your graduating class from high school?
7. Do you feel that you have done the best scholastic work that you are capable of doing?
8. In what activities and clubs were you involved while in high school?
9. How many days were you absent from school or work because of illness?
10. Have you had any serious illness?
11. Do you smoke?
12. Do you drink alcoholic beverages?
13. Do you like routine work?
14. Do you like regular hours of work?
15. How do you feel about working overtime?
16. Do you prefer a specific geographic location?
17. Are you willing to go where the company sends you?
18. What salary do you expect?
19. Have you had any difficulty getting along with fellow students and instructors?
20. Do you have any debts?
21. How do you spend your leisure time?
22. Do you have any other part-time duties?
23. Would you be interested in part-time training to improve your position with the company?
24. What is your major weakness?
25. When can you begin work?

ACROSS

1. Can be counted on
2. Reacts
3. Carries weight with boss
4. First step in getting job
5. Face to face encounter
6. Invitation or approval
7. Prim or well dressed
8. Late
9. Job assignments
10. Opposite of strength

DOWN

4. Mental set
11. Being friendly
12. Singular of people
13. Sick
14. Job, place, or posture
15. Either to teach or to learn
16. A very small part
17. Employment
18. Something owed
19. Personal belief



The degree of success attained by a worker on the job is largely dependent upon three factors: ability to perform the duties of the job skillfully; possession of the necessary understanding and knowledge; and the ability to get along with people on the job. It seems that skills and knowledge, even though important, cannot overcome the handicap of poor human relations. But by the same token, employers who ignore the principles of good human relations are plagued with disgruntled workers and usually have a high rate of labor turnover. A good employer-employee relationship is truly a two-way street requiring thoughtfulness, consideration and fair play on both sides.

Many new employees take for granted the various benefits provided by the employer. They would do well to understand that the benefits provided by management give them the right to expect something in return. Having the right attitude toward the employer will make the worker more successful on the job and a much more valuable employee. Here are some things an employer usually provides.

1. The employer provides a place to work and equipment to work with. This often includes land, buildings, and fixtures which may require a sizeable investment.

2. Employers usually do not expect new workers to be fully productive until they have been trained for the job. As a general rule, employers lose money on young workers while they are being trained. They may also invest many more dollars in the training of an enterprising worker for a supervisory position.

3. A business provides, as much as possible, pleasant surroundings in which to work. In addition to providing adequate space and equipment, many firms have eating facilities, hobby shops, and recreational activities for their employees.

4. The employer is responsible for salaries and other financial benefits. These may include various forms of insurance (medical, life, accident, and unemployment), advancement, retirement plans, holidays, vacations, discounts on purchases, and the handling of income tax deductions and social security accounts.

Employers have a right to expect cooperation and dependability in return for salaries and other benefits. These may include the following attitudes and characteristics on the part of the employee.

1. Honesty - It is surprising that some people think that "taking just a little" is not being dishonest. They will nonchalantly walk off with a quarter from the cash drawer, a candy bar from the counter, or a small tool or some other item from the tool room. Honesty means more, however, than just not taking things

that do not belong to you. It means giving a fair day's work for a fair day's pay; it means carrying out one's side of a bargain; it means that one's words convey true meanings and actual happenings. Our thoughts as well as our actions should be honest. Nothing brings quicker dismissal and disgrace for an employee than dishonesty. On the other hand, an employer will do much to keep an employee who is strictly honest.

2. Loyalty - Loyalty implies support of a cause, ideal, practice, or custom. It means being for a person or an organization. Between employer and employee it is a two-way proposition. Employees expect employers to look out for their interests, to provide them steady employment, to promote them to better jobs as openings occur. Employers feel that they too have a right to expect employees to be "for" them - to keep their interests in mind, to speak well of them to others, to keep any minor troubles strictly within the plant or office, and to keep absolutely confidential all matters that pertain to the business. Perhaps both employers and employees should keep in mind that loyalty is not something to be demanded; rather, it is something to be deserved.

   Loyalty takes time to mature and grow. It is the product of continued contact with a person or business over a period of time. New employees should not expect to receive this loyalty before proving themselves worthy of their supervisors' faith and confidence. Likewise business firms must earn loyalty from their employees. The good will and loyalty which develop between supervisors and employees are valuable commodities which are not to be treated lightly.

3. Willingness to learn - Almost every firm or business will have its own way of doing things. Employers expect their employees to be willing to learn these ways. Also the installation or use of new equipment or machines makes it necessary for even experienced employees to learn new methods and operations. It will be noted that workers who are promoted to jobs with greater responsibility are usually those who have taken the time and trouble to learn more than just their own daily tasks.

4. Willingness to take responsibility - Most employers expect their employees to see what needs to be done, then go ahead and do it. It is very tiresome to have to ask again and again that a certain job be done. When an employee is given directions about how to do a job, then the individual is expected to follow them exactly. It is generally true that responsibility should be delegated and not assumed. However, once the responsibility has been delegated, the employee should continue to perform the duties without further direction.

5. Respect for authority - Authority in industrial firms usually rests in managerial positions which are responsible for production, sales, or service as the case may be. It is the power or right to give commands, take actions, or make final decisions. Many places of business are small and uncomplicated, but the concept of respecting superiors is important even in the smallest of them.

6. Ability to get along with people - This is perhaps the most highly prized of all employee traits. For many the ability to get along well with people seems to come as a gift. To others it comes only as a result of painstaking thought and training. In order to acquire this ability one must learn to think of others as individuals; to be able to, at times, put oneself in another person's place; and to want sincerely to get along with others. Once acquired, the ability to get along well with people pays big dividends in friendships, popularity, and profits.

7. Willingness to cooperate - The employer who pays the salary has a right to expect full cooperation of the employee. One of the best ways to show a cooperative attitude is to offer to help other employees when one's assigned duties are completed. In many firms there are certain tasks that nobody likes to do. The employee who is willing to do these tasks will make a good impression on the boss and win the cooperation of fellow workers. One should learn to work as a member of a team with the employer, supervisors, and fellow workers. There should be a common effort to get the work done pleasantly and on time.

8. Rules and regulations - Not even two people can work well together unless there is some understanding as to what work shall be done, when it is to be done, and who shall do it. Rules and regulations are a necessity in any work situation. All new employees are expected to familiarize themselves with company policy and to adhere to it when on the job.

9. Tardiness and absenteeism - Tardiness refers to being late for work, and absenteeism means being off the job for one reason or another. Both are poor work habits that lead to reduced production. We are all creatures of habit in that we develop patterns of behavior and stick to them. The habit of being late may start in our early school days and then carry through the school years into our working lives. Developing the habit of getting up a few minutes earlier and doing a little better job of planning the morning schedule will help to break the tardiness habit.

   It is sometimes necessary to take time off from work. No one should be expected to work when sick or when there is serious trouble at home which demands attention. However, it is possible to get into the habit of allowing unimportant and unnecessary matters to keep us from the job. This results in lost production and hardship on those who try to carry on the work with less help. Again there is a principle involved. The person who hires us has a right to expect us to be on the job unless there is some very good reason for staying away. Certainly we should not let some trivial reason keep us home. We should not stay up nights until we are too tired to go to work the next day. If ill, we should do everything we can at home to recover more quickly.

   This brings up another matter about which employers have complained bitterly at times. If you do find it necessary to stay home, then at least telephone the place of business to tell the boss you will not be in. The supervisor can then make arrangements to compensate for your absence.

10. Performance review - There is now coming into use in more and more companies and firms a process called a performance review. Very simply, it is an evaluation of how individuals are performing their assigned duties. If necessary, possibilities of making improvements are suggested. In many larger electronics firms employees go through a period of probation of six months to a year. Their progress is evaluated both during and at the end of this time, and they then become permanent employees or are terminated. Many firms evaluate employee performance once a year and base pay raises on the evaluation. Reviews should be considered "constructive criticism" from the boss or supervisor, and if taken with a positive attitude can help one become a more productive employee. After all, remember that you are all on the same team.

11. Termination of employment - There exists in our present employer-employee relations an "unwritten law". It deals with termination of employer-employee relations. This is called "due notice" to employer by employee, and also "due notice" to employee by employer. Most of our employment today is based on this "unwritten law". Usually from one to two weeks in time, it allows both employer and employee time to make adjustments before termination without jeopardizing either. Simply quitting on a moment's notice, or worse yet not showing up for work, is in very poor taste and shows a lack of maturity. It leaves a work record behind that can "haunt" the individual when looking for a job.

EMPLOYER-EMPLOYEE RESPONSIBILITY VII-D-1(AS)

Name _____ Date _____

Directions: Each student will complete this assignment sheet on an individual basis. Answer the following discussion questions in complete sentences in the spaces provided.

1. Discuss some things an employee can do that they might not consider dishonest but actually are.

_____

_____

2. There is a saying that goes, "Don't bite the hand that feeds you." Restate it as it might apply to this lesson.

_____

3. What three things largely determine the degree of success attained by workers on the job?

a. _____

b. _____

c. _____

4. What are four things provided by employers in most job situations?

a. _____

b. _____

c. _____

d. _____

5. What are ten things an employer has a right to expect from an employee?

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

g. _____

h. _____

i. _____

j. _____

k. _____

Name _____ Date _____

Directions: This assignment sheet is to be completed on an individual basis. Solve the following problems using the Pythagorean Theorem method. Show all work on a work sheet and write your answers in the space provided. Round off your answers to three significant figures. If you have any questions, ask your instructor.

_____ 1. a = 2 & b = 3, c = ____
_____ 2. a = 28 & b = 13, c = ___
_____ 3. a = 4 & b = 27, c = ___
_____ 4. b = 27 & c = 27.3, a = __
_____ 5. b = 14 & c = 21.3, a = __
_____ 6. b = 683 & c = 726, a = ___
_____ 7. a = 18 & c = 46.6, b = ___
_____ 8. a = 33 & c = 71.1, b = ___
_____ 9. a = 357 & c = 549.7, b = __
_____ 10. a = 632 & b = 28, c = ____

Directions: Interpret your Trig function table for the indicated function and angle. Write your answer in the space provided. Do not round off your answers. If you have any questions, ask your instructor.

11. sin 21.0°=_____
12. sin 48.1°=_____
13. cos 28.5°=_____
14. cos 27.0°=_____
15. tan 45.0°=_____
16. tan 26.3°=_____
17. cos 1.0°=_____
18. cos 37.6°=_____
19. cos 28.6°=_____
20. cos 89.9°=_____
21. sin 26.3°=_____
22. sin 63.0°=_____
23. cos 43.8°=_____
24. cos 18.8°=_____
25. tan 72.4°=_____
26. sin 45.0°=_____
27. sin 1.0°=_____
28. cos 79.4°=_____
29. tan 25.2°=_____
30. tan 89.0°=_____
31. sin 42.7°=_____
32. sin 28.5°=_____
33. cos 52.3°=_____
34. cos 26.3°=_____
35. tan 15.2°=_____
36. cos 45.0°=_____
37. sin 30.0°=_____
38. tan 69.0°=_____
39. sin 89.9°=_____
40. tan 48.4°=_____

Directions: Interpret your table for the angle represented by the following functions. Use decimal fractions for parts of angles. Ex. 16.5°.

41. sin _____=.2588
42. cos _____=.5000
43. tan _____=16.83
44. sin _____=.8796
45. cos _____=.9836
46. cos _____=.9542
47. sin _____=.2011
48. tan _____=8.144
49. sin _____=.9998
50. sin _____=.0070
51. tan _____=3.631
52. tan _____=.1512
53. cos _____=.7593
54. sin _____=.9033
55. sin _____=.8290

Directions: Solve the following problems using Trigonometric functions. Show all your work on a work sheet. Round off your answers to three significant figures and write them in the space provided. If you have any questions, ask your instructor.

_____ 1. If the opposite side of a right triangle equals 100 and the hypotenuse equals 125, then sin θ equals _____.

_____ 2. In question 1, θ = _____.

_____ 3. If the hypotenuse of a right triangle equals 50 and the opposite side equals 30, then sin θ equals _____.

_____ 4. In question 3, θ = _____.

_____ 5. If the opposite side of a right triangle equals 25 and sin θ equals .6717, then the hypotenuse equals _____.

_____ 6. In question 5, θ = _____.

_____ 7. If the hypotenuse of a right triangle equals 600 and θ equals 27 degrees, then the opposite side equals _____.

_____ 8. If the opposite side of a right triangle equals 150 and θ equals 30 degrees, then the hypotenuse will equal _____.

_____ 9. If the hypotenuse of a right triangle equals 65 and θ equals 75 degrees, then the opposite side will equal _____.

_____ 10. If the opposite side of a right triangle equals 45 and θ equals 62 degrees, then the hypotenuse equals _____.

_____ 11. If the adjacent side of a right triangle equals 75 and the hypotenuse equals 100, then cos θ equals _____.

_____ 12. In question 11, θ = _____.

_____ 13. If the hypotenuse of a right triangle equals 58 and the adjacent side equals 15, then cos θ equals _____.

_____ 14. In question 13, θ = _____.

_____ 15. If the hypotenuse of a right triangle equals 350 and θ equals 46.6 degrees, then the adjacent side equals _____.

_____ 16. If the adjacent side of a right triangle equals 4,000 and θ equals 15.8 degrees, then the hypotenuse equals _____.

_____ 17. If the adjacent side of a right triangle equals 15 and the opposite side equals 30, then tan θ equals _____.

_____ 18. In question 17, θ = _____.

_____ 19. If the opposite side of a right triangle equals 35 and the adjacent side equals 5, then tan θ equals _____.

_____ 20. In question 19, θ = _____.

Name _____ Date _____

Directions: Read each statement carefully. Round off your answers to three significant figures and write them in the space provided. Be sure to check your answers. If you have any questions, ask your instructor.

_____ 1. A 40 Ohm resistance is in series with a 30 Ohm capacitive reactance across a 100 V sine wave source. What is the impedance of the circuit?

_____ 2. What is the current drawn from the source in the circuit in question #1?

_____ 3. What is the voltage across the resistor in question #1?

_____ 4. What is the voltage across the capacitor in question #1?

_____ 5. What is the phase angle in the circuit in question #1?

_____ 6. A 40 Ohm resistance and a 30 Ohm capacitive reactance are in parallel across a 100 Volt sine wave AC source. What is total circuit current flow in the circuit?

_____ 7. What is the current flow through the resistance in question #6?

_____ 8. What is the current flow through the capacitive branch in question #6?

_____ 9. What is the impedance of the circuit in question #6?

_____ 10. What is the phase angle in the circuit in question #6?

_____ 11. A resistance of 100 Ohms and an inductive reactance of 1.00 Ohm are in series across a 100 V sine wave AC source. What is the impedance of the circuit?

_____ 12. What is the total circuit current in the circuit in question #11?

_____ 13. What is the voltage across the resistor in question #11?

_____ 14. What is the voltage across the inductor in question #11?

_____ 15. What is the phase angle in the circuit in question #11?

_____ 16. A 50 Ohm resistance and a 50 Ohm inductive reactance are in parallel across a 100 V sine wave AC source. What is the current through the resistance?

_____ 17. What is the current through the inductance in question #16?

_____ 18. What is the total circuit current in question #16?

_____ 19. What is the impedance of the circuit in question #16?

_____ 20. A resistance and an inductance are connected in series. If the voltage across the resistance is 30 V and the voltage across the inductance is 40 V, the total applied voltage is _____.

_____ 21. In a series AC circuit, 2 A of current flows through a 20 Ohm resistance, a 40 Ohm inductive reactance and a 60 Ohm capacitive reactance. What is the voltage drop across the resistor?

_____ 22. What is the voltage drop across the inductor in question #21?

_____ 23. What is the voltage drop across the capacitor in question #21?

_____ 24. What is the impedance of the circuit in question #21?

_____ 25. What is the phase angle of the circuit in question #21?

Name _____ Date _____

Directions: Each student will complete this assignment sheet on an individual basis. Read each statement carefully and place the correct answer in the space provided. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

_____ 1. Components made from semiconductor materials are sometimes called _____ components.

_____ 2. Transistors are more reliable and are more efficient than vacuum tubes. (True/False)

_____ 3. Most modern electronic equipment utilizes ____ components.

_____ 4. List three advantages of semiconductor components over vacuum tubes.

_____ 5.

_____ 6.

_____ 7. The two basic semiconductor devices are diodes and _____.

_____ 8. The most sophisticated solid-state device is the _____.

_____ 9. Silicon and _____ are the two common semiconductor materials used to manufacture components.

_____ 10. Electrons in the outer shell of an atom are referred to as _____ electrons.

_____ 11. Semiconductor materials share valence electrons by forming _____ bonds.

_____ 12. Pure semiconductor materials are called _____ materials.

_____ 13. Electrons and holes move in the same direction through semiconductor materials. (True/False)

_____ 14. Adding impurities to pure semiconductor materials is called _____.

_____ 15. Semiconductor materials have a _____ temperature coefficient.

_____ 16. Boron and _____ are used to change the characteristics of semiconductor materials.

_____ 17. The majority current carriers in N-Type semiconductor materials are _____.

_____ 18. The majority current carriers in P-Type semiconductor materials are _____.

_____ 19. Transistors _____ (can/cannot) be made from germanium crystals.

_____ 20. Solid state devices will soon be replaced by vacuum tube. (True/False)

Name _____ Date _____

Directions: Read each statement carefully and place the correct answer in the space provided. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

_____ 1. A _____ is formed when a semiconductor crystal contains sections of N-Type and P-Type materials.

_____ 2. As a PN junction is formed, a _____ region is created.

_____ 3. The ____ voltage is created when the PN junction is formed.

_____ 4. To forward bias a diode, the ___ lead is connected to the negative terminal of the voltage source.

_____ 5. To reverse bias a diode, the ____ lead is connected to the negative terminal of the voltage source.

_____ 6. A forward biased diode has very _____ resistance.

_____ 7. A reversed biased diode has very _____ resistance.

_____ 8. The _____ carriers of the P and N materials sustain current flow in a forward biased diode.

_____ 9. The forward bias voltage must be greater than the ___ to turn on the diode.

_____ 10. When a diode is reversed biased, a small _____ current will flow.

_____ 11. A forward biased silicon diode will have a voltage drop of about _____ Volts across it.

_____ 12. A forward biased germanium diode will have a voltage drop of about _____ Volts across it.

_____ 13. Semiconductor diodes have a ____ temperature coefficient.

_____ 14. The maximum reverse bias voltage a diode can withstand without being destroyed is called the _____.

_____ 15. The N section of a diode is represented by the _____ in the diode symbol.

_____ 16. The P section of a diode is represented by the _____ in the diode symbol.

_____ 17. A diode is ____ biased when the cathode is connected to the negative side of the source voltage.

_____ 18. A junction diode is formed by pressing P and N type material together. (True/False)

_____ 19. A _____ may be used to mark the cathode end of a diode.

_____ 20. Diodes which must handle large forward currents are placed in a metal _____ package to help dissipate heat.

_____ 21. A/an _____ diode is used in the process of converting AC to DC.

_____ 22. A/an _____ diode is designed to operate in the breakdown region.

_____ 23. Zener diodes are usually used in applications where they are _____ biased.

_____ 24. Zener diodes are used in circuits for ____ voltage.

_____ 25. A/an ____ diode exhibits a negative resistance region in its characteristic curve.

_____ 26. Tunnel diodes are used at _____ frequencies.

_____ 27. The abbreviation LED stands for _____.

_____ 28. An LED gives off light when the current carriers _____ at the junction.

_____ 29. An LED must be _____ biased at about 1.5 to 2.0 Volts to be operated.

_____ 30. Several LED's can be combined to make an alpha-numeric ____.

DIODE TESTING

Name _____ Date _____

Objective: Upon successful completion, the student will be able to demonstrate a practical method to test diodes and identify their leads using a VOM.

Reference: Schuler, Electronics-Principles and Applications

Directions: Read the textbook reference. Make the measurements called for in the procedure. Record the results in the spaces provided for each diode. Be sure to check your measurements.

Procedure:

1. Measure the forward resistance of the diode using your VOM.
2. Measure the reverse resistance of the diode using your VOM.
3. Compare the two readings to determine if there is a high ratio between the measurements.
4. A high ratio indicates a good diode.
5. A low ratio indicated a defective diode.

Data:

	Forward Resistance	Reverse Resistance	Good or Bad
Diode #1			
Diode #2			
Diode #3			
Diode #4			
Diode #5			
Diode #6			
Diode #7			
Diode #8			
Diode #9			
Diode #10			

Name _____ Date _____

Directions: Read each statement carefully and place the correct answer in the space provided. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

_____ 1. A/an ____ is formed when a semiconductor crystal contains two sections of one type of material separated by a section of the other.

_____ 2. Electrons and holes are both used as current carriers in ____ junction transistors.

_____ 3. The ____ region of a transistor is heavily doped.

_____ 4. The ____ region of a transistor is thin and very lightly doped.

_____ 5. A bipolar junction transistor contains _____ junctions.

_____ 6. The arrow in the transistor symbol indicates the ____ lead.

_____ 7. The collector-base junction must be ____ biased for proper operation.

_____ 8. The emitter-base junction must be ____ biased for proper operation.

_____ 9. Silicon and ____ are used in the construction of bipolar transistors.

_____ 10. The most popular semiconductor material for transistor construction is _____.

_____ 11. The emitter of a PNP transistor emits ____ as the current carrier.

_____ 12. The collector of a/an _____ transistor collects electrons.

_____ 13. The emitter lead arrow in the schematic diagram symbol points in for a _____.

_____ 14. The emitter lead arrow in the schematic diagram symbol points out for a _____.

_____ 15. Draw the schematic diagram symbol for a PNP transistor.

_____ 16. Draw the schematic diagram symbol for an NPN transistor.

Directions: Read each statement carefully. Indicate if the statement is True or False by placing a T or F in the space provided. Be sure to check your answers.

_____ 17. A transistor in a TO-3 case would be used in a small signal amplifier.

_____ 18. Bipolar transistors made from silicon can withstand more heat.

_____ 19. Transistors made from germanium are never used.

_____ 20. Transistor junctions can be checked with an ohmmeter.

_____ 21. All transistors have the leads identified on the case.

_____ 22. Each junction of a transistor can be checked with the same procedure as a diode.

_____ 23. Data sheets are available for all semiconductor devices.

_____ 24. The positive and negative leads must be identified for checking transistors on an ohmmeter.

_____ 25. Some bipolar transistors do not use holes as current carriers.

Name _____ Date _____

Objective: Upon successful completion, the student will be able to demonstrate a practical method of testing transistors using a VOM.

Reference: Schuler, Electronics-Principles and Applications

Directions: Read the textbook reference. Make the measurements called for in the procedure. Record the results in the spaces provided for each diode. Be sure to check your measurements.

Procedure:
1. Measure the forward resistance of the emitter-base junction using your VOM.
2. Measure the reverse resistance of the emitter-base junction using your VOM.
3. Compare the two readings to determine if there is a high ratio between the measurements.
4. Repeat steps 1, 2, and 3 for the collector-base junction using your VOM.
5. A high ratio indicates a good junction.
6. A low ratio indicates a defective junction.

Data:		Forward Resistance	Reverse Resistance	Good or Bad
Q 1	Emitter-Base			
	Collector-Base			
Q 2	Emitter-Base			
	Collector-Base			
Q 3	Emitter-Base			
	Collector-Base			
Q 4	Emitter-Base			
	Collector-Base			
Q 5	Emitter-Base			
	Collector-Base			

Name _____ Date _____

Directions: Define each of the following terms in the space provided. You may use your textbook and class notes as reference. Be sure to use correct spelling and grammar. If you have any questions, ask your instructor.

1. Unipolar Transistor: _____

2. JFET: _____

3. Depletion Mode: _____

4. MOSFET: _____

5. Enhancement Mode: _____

6. UJT: _____

7. Negative Resistance: _____

8. Discrete Circuit: _____

9. DIP Package: _____

10. Substrate: _____

11. Monolithic IC: _____

12. Hybrid IC: _____

13. SCR: _____

14. Latch Circuit: _____

15. Gate: _____

Name _____ Date _____

Directions: Read each statement carefully and place the correct answer in the space provided. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

_____ 1. A/an ____ circuit is used to convert alternating current into direct current.

_____ 2. For safety, a/an ____ is used to provide isolation between the electronic circuit and the AC power line.

_____ 3. A/an ____ rectifier circuit requires only one diode.

_____ 4. A full-wave rectifier has a ripple frequency of ____.

_____ 5. A/an _____ rectifier requires four diodes and has a full-wave output.

_____ 6. A filter can be constructed by using only a _____.

_____ 7. Adding a filter circuit to a power supply will cause the output voltage to _____.

_____ 8. To keep the output voltage of a power supply constant with changing load currents, a/an ____ circuit should be used.

_____ 9. A/an ____ diode can be used to help regulate a power supply.

_____ 10. The source section of a power supply should contain a switch and a ____ for safety.

_____ 11. The first step in trouble shooting a power supply is to ____ the operation.

_____ 12. To reverse the output voltage of a half-wave rectifier, the _____ must be reversed.

_____ 13. Full-wave rectifiers are harder to filter than half-wave. (True/False)

_____ 14. The output voltage of a power supply can be affected by the ___ current.

_____ 15. A burned resistor may indicate another defective component in a power supply circuit. (True/False)

16. Draw the schematic diagram of a power supply using a transformer source, half-wave rectifier, RC L-type filter, resistor load and indicate the polarity of the output voltage. Be sure to switch and fuse the primary circuit.

17. Draw the schematic diagram of a power supply using a transformer source, full-wave rectifier, LC L-type filter, Zener diode regulator, resistor load and indicate the polarity of the output voltage. Be sure to switch and fuse the primary circuit.

18. Draw the schematic diagram of a power supply using a transformer source, bridge rectifier, LC Pi-type filter, IC regulator and a resistor load. Be sure to switch and fuse the primary circuit and indicate the polarity of the output voltage.

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. You may use your textbook and class notes as reference. Be sure to check you answers. If you have any questions, ask your instructor.

_____ 1. Gain is the basic function of all _____.

_____ 2. Small signal amplifiers are usually referred to as _____ amplifiers.

_____ 3. The formula for amplifier gain in terms of signal is _____.

_____ 4. The ___ amplifier produces a 180^{o} phase inversion.

_____ 5. The ___ amplifier is the most popular of the three possible configurations.

_____ 6. The common-base amplifier has a ___ input impedance.

_____ 7. The three basic types of amplifier coupling are ___, ___, and _____.

_____ 8.

_____ 9.

_____ 10. The most efficient class of amplifier is the _____.

_____ 11. The class of amplifier with the least amount of distortion is the _____.

_____ 12. The least efficient class of amplifier is the _____.

_____ 13. A ___ amplifier responds to the difference between two input signals.

_____ 14. Operational amplifiers have two inputs, a/an _____ and a/an _____.

_____ 15.

_____ 16. When ___, remember to check all connections and control settings.

_____ 17. An electronic device is _____ when it will work only some of the time.

_____ 18. Most operational amplifiers require _____ voltage power supplies.

_____ 19. Making a resistance measurement of a component is part of the _____ stage of the troubleshooting process.

_____ 20. Good troubleshooting is a ____ and orderly process.

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. You may use your textbook and class notes as reference. Be sure to check your answers. If you have any questions, ask your instructor.

_____ 1. An oscillator is an electronic circuit used to ___ an AC signal.

_____ 2. An amplifier with positive ____ will act as an oscillator.

_____ 3. All oscillator circuits produce sinusoidal waves. (True/False)

_____ 4. Positive or in phase feedback is also called ____ feedback.

_____ 5. An adjustable oscillator is called a _____.

_____ 6. An RC or RL tank circuit will have a/an ____ frequency.

_____ 7. A/an ____ oscillator uses a tank circuit with a tapped coil.

_____ 8. A/an ____ oscillator uses a tank circuit with two capacitors to provide a center tap.

_____ 9. To increase stability, a Colpitts oscillator can be series tuned to make a _____ circuit.

_____ 10. An amplifier will oscillate if provided with ____ feedback.

_____ 11. A/an ____ crystal can be used to control the frequency of an oscillator circuit.

_____ 12. To improve stability, a/an ____ amplifier can be placed between oscillators and other circuits.

_____ 13. An astable multivibrator circuit produces a ____ wave shape.

_____ 14. The astable multivibrator uses two ____ and RC time constants to determine frequency.

_____ 15. A tank circuit will produce a/an ____ sine wave.

_____ 16. Most oscillators produce a ____ AC signal.

_____ 17. If high frequency stability is required, a/an ____ controlled oscillator should be used.

_____ 18. Changes in temperature can cause changes in oscillator _____.

_____ 19. An oscillator can be an amplifier that provides its own input signal. (True/False)

_____ 20. Connecting test equipment to oscillator circuits can cause _____ effect.

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. You may use your textbook and class notes as reference. Be sure to check your answers. If you have any questions, ask your instructor.

_____ 1. A/an ___ circuit has only two signal values.

_____ 2. List six common applications of digital circuits.

_____ 3.

_____ 4.

_____ 5.

_____ 6.

_____ 7.

_____ 8. List three advantages of digital circuits.

_____ 9.

_____ 10.

Directions: Convert the following numbers and write your answer in the space provided. Be sure to check your answers.

_____ 11. 1011 Binary to Decimal

_____ 12. 1111 Binary to Decimal

_____ 13. 0111 Binary to Decimal

_____ 14. 27 Decimal to Binary

_____ 15. 9 Decimal to Binary

DIGITAL LOGIC GATES XI-B-1(AS)

Name _____ Date _____

Directions: For each of the seven logic gates, draw the schematic symbol, the truth table and write the Boolean expression. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

1. AND Gate:

Symbol | Truth Table | Boolean Expression

2. OR Gate:

Symbol | Truth Table | Boolean Expression

3. NOT Gate:

Symbol | Truth Table | Boolean Expression

4. NAND Gate:

Symbol | Truth Table | Boolean Expression

5. NOR Gate:

Symbol | Truth Table | Boolean Expression

6. XOR Gate:

Symbol | Truth Table | Boolean Expression

7. XNOR Gate:

Symbol | Truth Table | Boolean Expression

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. You may use your textbook and class notes as reference. Be sure to check your answers. If you have any questions, ask your instructor.

_____ 1. Sequential and _____ are the two types of logic circuits.

_____ 2. List the three gates used in combinational logic circuits.

_____ 3.

_____ 4.

_____ 5. To construct counters and registers, several ____ can be connected together.

_____ 6. Flip-flops have two _____ outputs.

_____ 7. An RS flip-flop has two inputs called _____ and _____.

_____ 8.

_____ 9. The most universal flip-flop is considered to be the _____.

_____ 10. The _____ input controls the action of a flip-flop.

_____ 11. Frequency division can be done using a _____ circuit.

_____ 12. Several ____ can be wired together to make a counter circuit.

_____ 13. Counters can be constructed to count up or down. (True/False)

_____ 14. Counter circuits must be built from flip-flops. (True/False)

_____ 15. What is the identification number of a TTL 4 bit binary counter IC?

_____ 16. A/an ____ can be used as a memory for a display segment.

_____ 17. Shift registers can be constructed using _____.

_____ 18. A/an _____ circuit is the basic addition digital circuit.

_____ 19. Two half adders and a/an ___ can be used to construct a full adder circuit.

_____ 20. Very few digital integrated circuits have manufacturer's specification sheets. (True/False)

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. You may use your textbook and class notes as reference. Be sure to check your answers. If you have any questions, ask your instructor.

_____ 1. Placing information on an RF carrier signal is called ____.

_____ 2. AM stands for _____ modulation.

_____ 3. FM stands for _____ modulation.

_____ 4. The ___ is an amplifier used to separate an oscillator from a power amplifier.

_____ 5. The ____ is used to radiate or receive the radio frequency from space.

_____ 6. The intermediate frequency of an AM receiver is _____.

_____ 7. Demodulation is done by the ____ circuit in an AM radio.

_____ 8. The ____ circuit is used to demodulate an FM radio wave.

_____ 9. A radio receiver uses a ____ oscillator to produce a wave to mix with the incoming RF carrier.

_____ 10. Telephone systems use copper wire, microwave and ____ to transmit audio signals.

Directions: On a separate sheet of paper, draw and label the block diagram of an AM radio receiver.

Directions: On a separate sheet of paper, draw and label the block diagram of an FM radio receiver.

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. You may use your textbook and class notes as reference. Be sure to check your answers. If you have any questions, ask your instructor.

_____ 1. The CPU or central processing unit contains the ___ or "brain" of the system.

_____ 2. A temporary visual display is provided by the CRT ___.

_____ 3. ROM stands for _____ Memory.

_____ 4. RAM stands for _____ Memory.

_____ 5. A computer that will "stand alone" is considered a ___ computer.

_____ 6. A/an ___ is used for permanent output of alpha-numeric data.

_____ 7. A/an ___ provides faster data access than a tape storage system.

_____ 8. List three biomedical electronic systems.

_____ 9.

_____ 10.

_____ 11. List two aviation electronic systems.

_____ 12.

Directions: On a separate sheet of paper, draw and label the block diagram of a personal type computer.

Name _____ Date _____

Directions: Each student will complete this assignment sheet on an individual basis. Read each statement carefully and place the correct answer in the space provided. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

_____ 1. The largest number of workers in the field of electronics are those who produce _____.

_____ 2. New applications and discoveries in electronics have caused the field to have a fantastic _____ in recent years.

_____ 3. Advances in electronics have given us a more efficient auto _____ system.

_____ 4. Electronic systems have helped ____ the number of people in goods production.

_____ 5. An increase in the number of electronic devices has caused a/an ____ in the number of people in service production.

_____ 6. Vocational training is designed to prepare a person for _____ employment.

_____ 7. Large companies often send employees to classes for _____ training.

_____ 8. Students who graduate from a technical school often receive a/an ____ degree.

_____ 9. The most advanced degree earns the person the title of _____.

_____ 10. One of the most important things a person must have to succeed in business is business _____.

Name _____ Date _____

Directions: Using your class notes, textbook, and any other references write a paragraph concerning the topics listed below. Check your work for sentence structure, spelling, and punctuation. Use your own words.

1. Russian economic system

2. Russian collective farms and garden plots

3. Bill of Rights and business freedom

4. Consumer control of production

5. Henry Ford's ideas

6. Small business in the U.S.A.

Name _____ Date _____

Directions: Each student will complete this assignment sheet on an individual basis. Read each statement carefully and place the correct answer in the space provided. You may use your class notes and textbook as reference. Be sure to check your answers. If you have any questions, ask your instructor.

_____ 1. What is the most important element in succeeding in business?

_____ 2. Name three types of business organization.

_____ 3.

_____ 4.

_____ 5. A self profile and a financial statement are used in a _____ proposal.

_____ 6. It can be said that mutual _____ is important between a borrower and a lender.

_____ 7. Taken together, advertising and merchandising are termed ____.

_____ 8. Prox, E.O.M., and Net are _____ terms.

_____ 9. Premium and dividend are _____ terms.

_____ 10. Cities regulate business locations with ____ ____ laws.

_____ 11. If you do not own a building but can buy insurance on it because of your business you have an insurable _____.

_____ 12. Name two kinds of insurance companies mentioned in this lesson.

_____ 13.

_____ 14. Compensation is another word for salary or _____.

_____ 15. Estimating the amount of money coming in and going out over a given period is a _____ projection.

_____ 16. One should never hire an employee until ____ are contacted.

_____ 17. Paid vacations and holidays are examples of _____.

_____ 18. The insurance a business buys to protect itself from lawsuit is _____.

_____ 19. If a business sponsors a little league team it is promoting ____.

_____ 20. A business that has the right to do business as an individual is a _____.

_____ 21. Advertising is used by business to increase _____

_____ 22. Inexperience and lack of ability causes _____% of business failures.

_____ 23. If you always do your best and stick to a job until it is done you are highly _____.

_____ 24. A leasing contract can be compared to a _____.

_____ 25. Before signing a leasing contract one should consult a/an _____.

TEST SECTION

TEST VII-A-1(T)

PROJECT RATING SHEET

Name _____ Date _____

Project: _____ Total Points: _____

CIRCUIT LAYOUT

0	1	2	3	4	5	LAYOUT AND ARTWORK NEATNESS
0	1	2	3	4	5	COMPONENT SPACING
0	1	2	3	4	5	CONDUCTOR AND PAD SIZE
0	1	2	3	4	5	MOUNTING
0	1	2	3	4	5	BOARD SIZE

SOLDERING

0	1	2	3	4	5	COLD SOLDER CONNECTIONS
0	1	2	3	4	5	EXCESS SOLDER
0	1	2	3	4	5	SOLDER BRIDGES OR SPLATTER
0	1	2	3	4	5	NEATLY TRIMMED COMPONENT LEAD

COMPONENT PLACEMENT

0	1	2	3	4	5	COMPONENTS IN CORRECT LOCATION
0	1	2	3	4	5	CORRECT POLARITY OBSERVED
0	1	2	3	4	5	PARTS SEATED ON BOARD
0	1	2	3	4	5	COMPONENT MARKINGS VISIBLE

PACKAGING

0	1	2	3	4	5	ADEQUATE SIZE AND STYLE
0	1	2	3	4	5	PARTS WELL FASTENED
0	1	2	3	4	5	CONTROLS IDENTIFIED

WORKMANSHIP

0	1	2	3	4	5	NEAT WIRING
0	1	2	3	4	5	OVERALL APPEARANCE
0	1	2	3	4	5	WORKMANSHIP
0	1	2	3	4	5	PROPER OPERATION

TEST VII-B-1(T)

Name _____ Date _____

Directions: Read each question or statement carefully. Write the answers in the spaces provided.

1. List five methods a person can use to find a job.

   a. _____

   b. _____

   c. _____

   d. _____

   e _____

2. Name two ways a newspaper can be used to find a job.

   a. _____

   b. _____

3. If you plan to use someone for a reference, what is the first two things you should do?

   a. _____

   b. _____

4. What should you put for an answer if the question asked on an application does not relate to you?

   _____

5. So that you do not have to rely on memory, what should you take with you when applying for a job?

   _____

   _____

TEST VII-D-1(T)

Name _____ Date _____

Directions: Read the following statements carefully. Some of them are true and some of them are false. Write your answer in the space provided. Check your answers before turning in your paper.

_____ 1. Human relations can be described as a one-way street.

_____ 2. Employers would like new employees to be very productive.

_____ 3. Being disgruntled means an employee is happy.

_____ 4. Most employers lose money on new employees.

_____ 5. Salaries and wages are called fringe benefits.

_____ 6. Employees who want to learn are more valuable than others who do not.

_____ 7. One must work hard to earn an employer's confidence.

_____ 8. Newer employees should do dull, boring jobs before anyone tells them to.

_____ 9. If you are friendly and cooperative on the job, you are considered an asset to the firm.

_____ 10. The tardiness habit learned in high school often carries over to the job.

_____ 11. If you have the flu you should go to work and do the best you can.

_____ 12. A performance review often results in a merit raise.

_____ 13. Giving constructive criticism means the supervisor is hoping to help the employee become more productive.

_____ 14. One should call in to terminate employment.

_____ 15. "Due notice" is a common courtesy that is the responsibility of both employers and employees.

TEST VIII-A-1(T)

AC MATHEMATICS

Name _____ Date _____

Directions: Read each statement carefully. Select the word or words which best completes the statement and write them in the space provided. Be sure to check your answers. For questions 1 - 6, identify the parts of the triangle in figure 1 by name.

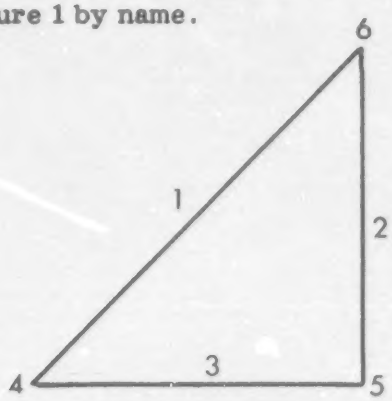


figure 1

_____ 1.

_____ 2.

_____ 3.

_____ 4.

_____ 5.

_____ 6.

_____ 7. ____ gives us methods and procedures for calculating the lengths of the sides and the angles of a triangle.

_____ 8. A right triangle is a three-sided geometric figure that has one angle of _____ degrees.

_____ 9. The sum of the three angles in any triangle is always ____ degrees.

_____ 10. Quantities which have direction as well as magnitude are called _____ quantities.

_____ 11. The trig function _____ can be found by dividing side 2 by side 1 in figure 1.

_____ 12. The trig function ____ can be found by dividing side 2 by side 3 in figure 1.

_____ 13. The trig function ____ can be found by dividing side 3 by side 1 in figure 1.

_____ 14. In figure 1, if side 1 is 450 and side 2 is 300 then 4 will be _____.

_____ 15. In figure 1, if side 1 is 28 and side 3 is 15 then 4 will be ____.

_____ 16. In figure 1, if side 1 is 156.5 and side 3 is 27.5 then 5 will be _____.

_____ 17. In figure 1, if side 1 is 36 and 4 is 27.8 degrees then side 2 will be _____.

_____ 18. In figure 1, if side 3 is 54 and 6 is 27 degrees then 4 will be _____.

_____ 19. In figure 1, if 1 is 8 and 4 is 13.6 degrees then 2 will be ____.

_____ 20. In figure 1, if 1 is 15 and 2 is 10, then 3 will be _____.

TEST VIII-B-1(T)

R-L-C CIRCUITS

Name _____ Date _____

Directions: Read each statement carefully. Each has four possible answers lettered A, B, C, and D. Write the letter representing the best answer in the space provided. Be sure to check your answers.

_____ 1. The unit of measure for impedance is the ____.
A. Ohm B. Henry C. Ampere D. Farad

_____ 2. When an inductor has 6 Ohms of resistance and 8 Ohms of reactance is across 120 VAC, current flow through the circuit is _____.
A. 8.6 A B. 35 A C. 10 A D. 12 A

_____ 3. The phase angle is _____ degrees if the resistance in a circuit is 90 Ohms and the capacitive reactance is 90 Ohms.
A. 90 B. 45 C. 0 D. 180

_____ 4. The impedance of a 1000 Ohm resistor in series with a 1000 Ohm inductive reactance equals ____ Ohms.
A. 500 B. 707 C. 1 K D. 1.4 K

_____ 5. The power factor of an AC circuit equals
A. the cosine of the phase angle.
B. zero.
C. current times voltage.
D. one if the resistance is zero.

_____ 6. If 2 A of current is flowing in the resistive branch and 2 A is flowing in the inductive branch of a parallel circuit, the supply current is _____.
A. 1.00 A B. 2.00 A C. 2.80 A D. 4.00 A

_____ 7. The power dissipated in a series RC circuit with 10 Ohms of resistance and 10 Ohms of capacitive reactance having an effective current flow of 3 A is _____.
A. 30 W B. 90 W C. 42.4 W D. 127 W

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Answers to calculations should have three significant figures and written using the proper metrix prefix. Be sure to check your answers.

_____ 8. A 500 Ohm resistance is in series with a 300 Ohm capacitive reactance. What is the impedance of the circuit?

_____ 9. A 300 Ohm resistance is in series with a 500 Ohm inductive reactance. What is the impedance of the circuit?

_____ 10. In a series AC circuit, 2.00 A of current flows through a 20 Ohm resistance, a 40 Ohm inductive reactance and a 60 Ohm capacitive reactance. What is the voltage across the resistor?

_____ 11. What is the voltage drop across the inductor in question #10?

_____ 12. What is the voltage drop across the capacitor in question #10?

_____ 13. What is the source voltage in question #10?

_____ 14. What is the impedance of the circuit in question #10?

_____ 15. What is the phase angle in the circuit in question #10?

TEST IX-A-1(T)

Name _____ Date _____

Directions: Read each statement carefully. Place the word or words which best completes the statement in the space provided. Be sure you use correct spelling and check your answers.

_____ 1. Semiconductor materials have a _____ temperature coefficient.

_____ 2. By _____ a semiconductor materials, changes in its electrical characteristics are made.

_____ 3. Majority carriers for P-Type semiconductor materials are _____.

_____ 4. _____ semiconductor material is more sensitive to heat damage than other semiconductor materials.

_____ 5. The majority carriers in N-Type semiconductor materials are ___.

_____ 6. Pure semiconductor materials are called ____ materials.

_____ 7. The outermost electron orbit of an atom is called the _____ shell.

_____ 8. List four advantages of semiconductor devices.

_____ 9.

_____ 10.

_____ 11.

_____ 12. A/an ____ circuit only has two voltage values.

_____ 13. A/an _____ circuit can have an infinite number of voltage values.

_____ 14. An advanced and complex solid state device is the _____.

_____ 15. Semiconductor devices are made from pure semiconductor materials. (True/False)

TEST IX-B-1(T)

Name _____ Date _____

Directions: Read each statement carefully. Place the word or words which best completes the statement in the space provided. Be sure to use correct spelling and check your answers.

_____ 1. The ___ voltage is created when the PN junction is formed.

_____ 2. The ___ carriers of the P and N materials sustain current flow in a forward biased diode.

_____ 3. As a PN junction is formed, a _____ region is created.

_____ 4. A forward biased silicon diode will have a voltage drop of about 0.2 Volts across it. (True/False)

_____ 5. A forward biased diode has very ___ resistance.

_____ 6. The cathode lead of a diode is connected to the negative terminal of the source to forward bias the diode. (True/False)

_____ 7. The forward bias voltage must be greater than the ___ to turn on the diode.

_____ 8. Semiconductor diodes have a ___ temperature coefficient.

_____ 9. The P section of a diode is represented by the ___ in the diode symbol.

_____ 10. A Zener diode is designed to operate in the breakdown region. (True/False)

_____ 11. A/an ___ diode exhibits a negative resistance region in its characteristic curve.

_____ 12. The maximum reverse bias voltage a diode can withstand without being destroyed is called the _____.

_____ 13. A ___ is placed on the cathode end of a diode.

_____ 14. Metal cases are used on diodes to help prevent heat damage. (True/False)

_____ 15. An LED gives off light when the current carriers ___ at the junction.

Name _____ Date _____

Directions: Read each statement carefully. Place the word or words which best completes the statement in the space provided. Be sure to check your answers.

_____ 1. Electrons and holes are used as current carriers in ____ junction transistors.

_____ 2. Transistor junctions can be checked with an ohmmeter. (True/False)

_____ 3. The ____ region of a transistor is thin and very lightly doped.

_____ 4. Some bipolar transistors do not use holes as current carriers. (True/False)

_____ 5. A bipolar junction transistor contains _____ junctions.

_____ 6. The ____ junction must be reverse biased for proper operation.

_____ 7. Each junction of a transistor can be checked with the same procedure as a diode. (True/False)

_____ 8. The emitter-base junction must be ____ biased for proper operation.

_____ 9. All transistors have the leads identified on the case. (True/False)

_____ 10. The emitter of a PNP transistor emits ____ as the current carrier.

_____ 11. The ____ section of a bipolar transistor collects the current carriers.

_____ 12. The emitter lead arrow in the schematic diagram symbol points in for a ____.

_____ 13. Bipolar transistors made from silicon can withstand more heat than transistors made of germanium. (True/False)

_____ 14. Transistor case types are identified using TO. TO stands for ____.

_____ 15. Draw the schematic symbol for an NPN transistor.

TEST IX-D-1(T)

Name _____ Date _____

Directions: Read each statement carefully. Place the word or words which best completes the statement in the space provided. Be sure to check your answers.

_____ 1. A very common IC package is the DIP package. DIP stands for _____.

_____ 2. There are three junctions in an SCR. (True/False)

_____ 3. A silicon controlled rectifier is a _____ controlled device.

_____ 4. Field effect transistors are current controlled devices. (True/False)

_____ 5. A/an ____ has three leads: source, gate, and drain.

_____ 6. When the forward current in an SCR drops to zero, the device is turned _____.

_____ 7. Integrated circuits usually contain diodes, transistors, resistors and inductors. (True/False)

_____ 8. An unijunction transistor exhibits a unique characteristic called _____.

_____ 9. Discrete components are individually connected in the circuit. (True/False)

_____ 10. The ____ is the ceramic or silicon material which is used to construct semiconductor components on.

TEST X-A-1(T)

Name _____ Date _____

Directions: Read each statement carefully. Place the word or words which best completes the statement in the space provided. Be sure to check your answers.

_____ 1. A/an ____ rectifier circuit requires only one diode.

_____ 2. A/an ____ rectifier requires four diodes and has a full-wave output.

_____ 3. A/an ____ circuit is used to convert alternating current into direct current.

_____ 4. Adding a filter circuit to a power supply will cause the output voltage to _____.

_____ 5. For safety, a/an _____ is used to provide isolation between the electronic circuit and the AC power line.

Directions: Draw the schematic diagram of a power supply using a transformer source, bridge rectifier, LC Pi-type filter, Zener diode regulator and a light emitting diode for a load. Be sure to switch and fuse the primary circuit and indicate the polarity of the output voltage.

TEST X-B-1(T)

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

_____ 1. Small signal amplifiers are usually referred to as ____ amplifiers.

_____ 2. Gain is the basic function of all ____.

_____ 3. The ____ amplifier produces a 180^{o} phase inversion.

_____ 4. The three basic types of amplifier coupling are ____, ____, and ____.

_____ 5.

_____ 6.

_____ 7. The most efficient class of amplifier is the ____.

_____ 8. The class of amplifier with the least amount of distortion is the ____.

_____ ____ 9. A ____ amplifier responds to the difference between two input signals.

_____ 10. Operational amplifiers have two inputs, a/an ____ and a noninverting.

_____ 11. Most ____ amplifiers require duel voltage power supplies.

Directions: Match the item in column A with the item in column B. Write the letter representing your answer in the space provided.

	Column A	Column B
_____	12. Class A	A. Operates at cut off
_____	13. Class B	B. Extreme Distortion
_____	14. Class AB	C. High Power Audio Work
_____	15. Class C	D. Low Distortion

TEST X-C-1(T)

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

_____ 1. A/an ____ oscillator uses a tank circuit with a tapped coil.

_____ 2. Positive or in phase feedback is also called _____ feedback.

_____ 3. All oscillator circuits produce sinusoidal waves. (True/False)

_____ 4. An amplifier with positive ____ will act as an oscillator.

_____ 5. A/an ____ crystal can be used to control the frequency of an oscillator circuit.

_____ 6. An oscillator is an electronic circuit used to _____ an AC signal.

_____ 7. An RC or RL tank circuit will have a/an ____ frequency.

_____ 8. A/an ____ oscillator uses a tank circuit with two capacitors to provide a center tap.

_____ 9. If high frequency stability is required, a/an ____ controlled oscillator should be used.

_____ 10. Changes in ____ can cause changes in oscillator frequency.

TEST XI-A-1(T)

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

_____ 1. List two advantages of digital circuits.

_____ 2.

_____ 3. A digital circuit has only _____ signal values.

_____ 4. List four common applications of digital circuits.

_____ 5.

_____ 6.

_____ 7.

Directions: Convert the following numbers and write your answer in the space provided. Be sure to check your answers.

_____ 8. 1011 Binary to Decimal

_____ 9. 0101 Binary to Decimal

_____ 10. 1000 Binary to Decimal

_____ 11. 1111 Binary to Decimal

_____ 12. 0111 Binary to Decimal

_____ 13. 26 Decimal to Binary

_____ 14. 11 Decimal to Binary

_____ 15. 13 Decimal to Binary

TEST XI-B-1(T)

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

_____ 1. The ____ gate must have both inputs at logic high to have an output that is high.

_____ 2. Either input must be high to have a high output in a/an ___ gate.

_____ 3. A/an ___ gate complements the input.

_____ 4. An inverter is also known as a/an ____ gate.

_____ 5. The universal gate is the ____ gate.

_____ 6. The ____ is the Boolean symbol for OR.

_____ 7. The Boolean expression, A + B = Y represents the ____ gate.

_____ 8. The NOR gate acts as an OR gate except the output is ____.

_____ 9. The logic symbol for an XNOR gate is _____.

10. Complete the following truth table for a NAND Gate.

INPUTS		OUTPUT
A	B	Y
0	0	
0	1	
1	0	
1	1	

TEST XI-C-1(T)

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

_____ 1. To construct counters and registers, several ___ can be connected together.

_____ 2. An ___ flip-flop has two inputs called set and reset.

_____ 3. Flip-flops have two outputs which are considered _____ with each other.

_____ 4. The most universal flip-flop is considered to be the ___.

_____ 5. Frequency division can be done using a _____ circuit.

_____ 6. The ___ input controls the action of a flip-flop.

_____ 7. Several ___ can be wired together to make a counter circuit.

_____ 8. Counters can be constructed to count up or down. (True/False)

_____ 9. A/an ___ can be used as a memory for a display segment.

_____ 10. Two half adders and a/an ___ can be used to construct a full adder circuit.

Directions Draw the logic symbol and complete the Truth Table for a JK Flip-Flop.

TEST XII-A-1(T)

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

_____ 1. The ____ is an amplifier used to separate an oscillator from a power amplifier.

_____ 2. Placing information on an RF carrier signal is called ____.

_____ 3. The ____ circuit is used to demodulate an FM radio wave.

_____ 4. A radio receiver uses a ____ oscillator to produce a wave to mix with the incoming RF carrier.

_____ 5. Telephone systems use copper wire, microwave and ____ to transmit audio signals.

Directions: In the space below, draw and label the block diagram of an FM radio receiver.

TEST XII-B-1(T)

Name _____ Date _____

Directions: Read each statement carefully. Write the word or words which best completes the statement in the space provided. Be sure to check your answers.

_____ 1. Operator input of alpha-numeric data is through the _____.

_____ 2. RAM stands for _____ Memory.

_____ 3. The CPU or central processing unit contains the _____ or "brain" of the system.

_____ 4. A/an ____ is used for permanent output of alpha-numeric data.

_____ 5. A/an _____ provides faster data access than a tape storage system.

Directions: Draw and label the block diagram of a personal type computer in the space below.

TEST XII-A-1(T)

Name _____ Date _____

Directions: Read each of the following statements carefully. After deciding whether it is true or false, make a T or F in the blank that corresponds. Check your answers.

_____ 1. Goods production employs the largest number of workers in industry.

_____ 2. A saturated market has caused a decline in the electronics industry.

_____ 3. A better electronic ignition system has helped automobiles to get better gasoline mileage than was possible before.

_____ 4. The greatest factor in business success or failure is the individual who runs it.

_____ 5. In order to get a bachelor of science degree, one must attend a technical school.

_____ 6. A person should learn to learn before going to a technical school or college.

_____ 7. Science and math are tools used by technicians working in electronics.

_____ 8. Home study in electronics is a method of improving trade skills.

_____ 9. After attaining the doctorate, one should consider oneself at the top of the ladder and stop studying.

_____ 10. Starting out as a hobby has led to many successful businesses.

ESSAY TEST XIII-B-1(T)

Name _____ Date _____

Directions: Write a one-page essay comparing the free enterprise system with the socialistic economic system. Outline your essay on a separate page before beginning. You may use reference materials, but keep direct quotes to a minimum.

Directions: Using your class notes and other references write a paragraph concerning the topics listed below. Check your work for sentence structure, spelling, and punctuation. Use your own words.

1. A business owner can be compared to the captain of a ship. Explain this.

2. Why is the business location so very important?

3. Explain why you would or would not consider going into a franchise agreement.